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THE WATER AND SEWER WORKS OF THE CITY OF BOSTON

1630 - 1978

THE WATER AND SEWER WORKS OF THE CITY OF BOSTON 1630 - 1978

by NEIL J. SAVAGE

'Tis a little thing
To give a cup of water; yet its draught
Of cool refreshment, drained by fevered lips;
May give a shock of pleasure to the frame
More equisite than when nectarean juice
Renews the life of joy in happiest hours.

ION. ACT 1, SCENE 2
Sir Thomas Noon Talfourd (1794 - 1854)

As one who long in populous city pent,
Where houses thick and sewer annoy the air.

Paradise Lost. Book VIII, Line 445
John Milton (1608 - 1674)

THIS HISTORY WAS COMMISSIONED BY THE BOSTON WATER AND SEWER COMMISSION

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BOSTON, MASSACHUSETTS
JULY, 1981

THE WATER AND SEWER WORKS OF THE CITY OF BOSTON

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Chapter 1

Governor John Winthrop of the Massachusetts Bay Colony and his fellow immigrants had been eighteen weeks out of Salem following the irregular coast line in search of their permanent place of settlement in the New World when they landed at Charlestown in June of 1630. Death debarked with them.

Ill provisioned because they believed the glowing reports of the land's ability to support them, and having neither the experience nor knowledge to properly set up their encampment, scurvy and dysentry overcame them and soon almost every household would count one dead and in some more. They lived from the offerings the sea over which they had arrived gave up - mussels, lobster and clams. But what they needed most and without which there was no hope of survival was a supply of pure fresh water.

Charlestown had water, but it lay still in ponds. The Puritans trusted only water that was in motion, believing that its movement purified it. They were told that the White settler who had preceded them, Rev. William Blackstone, had an "excellent spring"[1] near the place where he lived, on the slope of one of the hills across the Bay in Trimountaine. So they crossed the salt water to find fresh, and found a copious and pure supply in a spring near what is now called Dock Square.[2]

1. The Colonial Society of Massachusetts, April, 1907, p. 295.
2. Ibid. p. 297.

On the 7th of December, 1630, in the well practiced terseness that was their style, the members of "The Court of Assistans holden at Charleston (Charlestown) ---ordered that "Trimountaine shalbe called Boston, Mattapan, Dorchester; & the Towne upon the Charles Ryver, Watertown."[1] Thus the followers of Winthrop changed the name which described the hills that dominated that place of river, inlets, streams, islands, and peninsula to that of the place from whence many of them had come - Boston in Lincolnshire, England.

It was not the first time the name had been changed. Its Indian inhabitants called it Shawmut, the place of living springs. Blackstone's excellent spring lay quite close to where he lived on the slope of Beacon Hill near Louisburg Square. (Ultimately, Mr. Blackstone was invited to join the Church, but demurred, saying: "I came from England because I did not like the Lord Bishops, but I can't join you because I would not be under the Lord-Brethern," and abandoned his home, and the Puritans were convinced, his soul, fleeing to the wilds of Rhode Island).[2]

As the Town of Boston began its slow growth, people settled further from the spring and carrying water became a burden. In 1650, several inhabitants of North Street approached William Tynge, already one of the richest merchants of the Town, and

1. The Records of the Colony of Massachusetts.
2. Cotton Mather, Magnalid (1702) book xxiii, p. 7.

asked if he would supply them water from the spring behind his house. On June 1st, 1652 the Great and General Court incorporated Boston's first water works - "for the dayly use of fresh water for their several families, and especially the eminent danger if any scathfier should happen amoungst them (which God forbid)." The water rents were to be paid to Mr. Tynge - twelve pence a year - and the Corporation was to meet annually on the first of July - "if not the Lord's day, or if it be, then on the second"[1] to elect two wardens to serve for a year and no more. The wardens were to see to the works, had authority to seize property of those who did not pay for the water and to prevent anyone who was not a member of the Corporation from taking water by first warning them and then if they persisted, taking from them the vessel in which they had intended to carry away water.

The wardens were also authorized to give license to draw water to those too poor to pay for it, and anyone was authorized to break into the works at any place in case of fire.[2]

The conduit was a large reservoir about twelve feet square holding water conveyed from wells and springs by wooden pipes. Over the reservoir a wooden building was constructed for storage, but later the well was covered with planks rising to a level about two feet high with sloping sides. The pipes had been laid some time earlier and the length they travested North Street became known as Conduit Street.

1. Massachusetts Colony Records, Vol. Iv. Part 1 p 99 (June 1, 1652)
2. Ibid.

As the years passed and the Town grew, watersheds were destroyed, springs covered over and built upon or dried up. Slowly a dependence grew for the needed supply on dug wells or cisterns used to catch rain water. And it was becoming apparent that the quality of such water was not that of the springs.

In 1793, B. J. Ferron, who held the imposing title of "Surgeon-Major of his Most Christian Majesty's Squardron under Maetanay's Command in North America, and His Majesty's Marine Hospitals at Boston and in Rhode Island"[1] experimented with several samples of well water taken in different parts of Boston to determine its quality. The analysis of water in those days was an inexact science at its best. Nevertheless Ferron wrote: "From the various experiments, may we not conclude that the water of Boston contains sea salt with a base of mineral ackali in small quantity of oil, perhaps a little tal catharticus amarus. There are besides some which contain farther a superabundance of earth, suspended by means of an undue proportion of air."[2]

Toward the end of the eighteenth century, some of Boston's "capitalists" as they proudly called themselves in those days, became convinced that there was a market for the sale of water to the inhabitants of the Town. But there was no large supply to be found in Boston. They turned to the neighboring Town of Roxbury and to its Jamaica Plain section where was located a

1. Proceedings of the American Academy of Arts and Sciences - 1793 in English and French.
2. Ibid.

Pond of approximately seventy acres with a depth, in some sections, of up to sixty or seventy feet.

In 1698 the rights to the waters of the Pond had been granted by the Town to one Joseph Belnap with permission to draw water for the operation of a grist mill to grind corn for the inhabitants of Roxbury and Brookline. In 1739 the Selectmen decided to regulate the amount which could be drawn. In October of 1780, the Grist Mill was diverted to other uses and in February of 1784, because the surface of the Pond had fallen, it was ordered that the drain be entirely stopped six feet to the eastward of the Gate "until the season would admit to a good look at the source."[1]

In 1795, the backers of the proposed water works petitioned the Great and General Court for a charter to proceed with the project. In their petition they proclaimed that they had purchased the rights to the pond from William Marshall (he had purchased them the previous year) and that they were convinced "great quantities of water can be drawn the greater part of the year" and pointed out that it was "impossible to maintain the health of the people without washing sheets in Summer and in Autumn" (which was the only times each year that they were), and further raised the spectre of "other Cities ravaged by fire - at great expense."[2]

1. Drake's History of Roxbury.
2. Records of the Proprietors of the Boston (Jamaica Plain) Aqueduct Corporation 1795.

The Act of Incorporation was passed by both branches of the Legislature on February 26, 1795 and signed the next day by Govenor Samuel Adams. The first meeting of the Corporation was to be "holden at the Bunch of Grapes Tavern in Boston"[1] on the same day at 12 noon. In attendance were Laommi Baldwin, Jr. who was to be the Engineer for the construction of the works and Charles Bulfinch, its architect.

To raise funds, the Incorporators sold, or attempted to sell, 100 shares at $1,300 per share. Two mains were originally laid. There later would be four, two of four inch bore and two of three inch and made of pitch-pine, laid into Boston in a subterranean tunnel there to be connected to the lateral pipes, one and one half inches in diameter, of the subscribers. Both the Towns of Boston and Roxbury had free access to the hydrants the Corporation built, in case of fire.

The Boston Aqueduct Corporation, more commonly known as the Jamaica Pond Aqueduct, had its problems from the beginning. Shares were hard to sell, revenues from water rents (set by the Legislature) proved inadequate to cover expenses and assessments were repeatedly laid on the shareholders. At one point the selling price of the shares fell to $500.00. No dividends were paid for ten years. The works were in constant need of repair as the wooden pipes often broke, especially where one length was connected with the next. (This was done by

1. Ibid.

dovetailing the narrow end of one length into the wider end of the next and sealing the joint with an iron ring. Wear often caused these joints to separate. The Works long time Chief Engineer, Mr. Thomas Dexter, developed an extraordinary skill at locating the leaks without excessive digging. Forcing an iron rod down through the earth until he hit the top of the pipe, he would strike the rod and listen, with his ear against it, to the resulting sound. Its tone would tell him how far away the break was. The method was most effective and left Mr. Dexter deaf.

Waste was, as it is now, a great problem for the water works. Rates were charged by the size of the family (with different rates for hotels, manufacturies and commercial houses). The users of the water were very careless, often not turning off their stop cocks. But despite all its problems, the Jamaica Pond Aqueduct brought a supply of water, albeit not always sure and steady, to several sections of Boston (the Pond was not elevated enough to supply the high sections of the Town by gravity flow) for over fifty years and at its demise was supplying between 1,500 and 1,600 hundred households and other users, including the Massachusetts General Hospital, and homes and business far up Washington and Tremont Street in the City. By 1844 it had 55 large (50,000 gallons) and 9 small (25,000) reservoirs in the City. The fire hydrants when, in reality, plugs in the pipes which the fire companies (over most of the life of the Aqueduct, private companies which dashed to the

fire hoping to be the first there and if they were not, prepared to fight it out with whomever was) could pull out so that water might be pumped.

Chapter II

Although many were reluctant to see it happen, the growth of Boston had been such that it was forced to abandon the rather cumbersome and informal Town Meeting form of government and petition the General Court for an act incorporating it as a City. The City charter was accepted by the Town on March 4, 1822. The names of two illustrious citizens of the new City were proposed to be its first Mayor - Harrison Grey Otis and Josiah Quincy, but support for each was so evenly divided that a compromise choice was made, John Phillips. The ascent of Quincy to Mayor was to come in 1823. He would be called by many the "Great Mayor."

In his inaugural address, Quincy turned, with his usual optomistic enthusiasm to the question of a supply of pure water to all sections of the City. He urged that a supply be brought in and suggested as potential sources the Charles and Neponset Rivers. It would be twenty-five years later, a quarter of a century of surveys, controversies, elections, legislation, petitions, remonstrances and argument, sometimes, of a gentlemanly character, and sometimes not, before his son, Mayor Josiah Quincy, Jr., would pull a lanyard on Boston Common to allow the water to flow into the Frog Pond and through the newly laid pipes of the City.

Mayor Quincy's plea for water, while not immediately heeded, did set the project into intellectual motion.. By 1825, the City Council (Common Council and Board of Aldermen sitting jointly) appointed a Committee to look into the acquisition of a supply of water. Mayor Quincy was its Chairman. The joint Committee hired Daniel Treadwell to conduct a survey. As the project would stir the passions of the City, it also would, through its history, attract men outstanding in themselves and in their professions.

Treadwell, an orphan at eleven, had been apprenticed to his older brother as a Silversmith. He eventually became successful in that craft on his own. Yet, like many men of quality who lacked formal education, he had a thirst for knowledge and spent much time in available libraries reading. Treadwell's desire for learning was matched by his love of invention. He created a machine to produce screws, one to make hemp, and a printing press that was operated by the weight of the pressman's foot using an ingenious combination of levers and a toggle joint. His press was later improved to print on both sides of the paper simultaneously and eventually was operated by steam power. Treadwell was early on interested in the embryonic railroad system of America and his sketches illustrating a system of turnabouts allowed the construction of single track railroads. He shared his self-gained knowledge through a series of lectures to working men on the application

of scientific principles to their labor. In 1834 he was appointed Rumford Professor and Lecturer on the Application of Science to the Useful Arts at Harvard College.

Treadwell began his report of November 4, 1825 with a determination of just how much water the City needed. Assuming the population of Boston would be approximately 50,000 when the water arrived and using the consumption figures of the Cities of Philadelphia and London, he reckoned by interpellation that the City ought to have 1,458,000 gallons daily. But he was dissatisfied with that figure on the grounds that the pattern of consumption of the citizens of Boston might not be the same as that of their counterparts in Philadelphia and London. So he devised his own formula.

He began by assuming the 50,000 people in the City were gathered in 8,000 families. Giving each family 100 gallons a day for cooking and washing and other uses, would require a supply of 800,000 gallons. But not all citizens would find the same day propitious for washing either themselves or their clothes. He assumed, therefore, that 6,000 would coincidently wash each day using 60 of their hundred gallons and those not cleaning up would use 40 for "other purposes" thus making a daily total use of 680,000 gallons. Add another 500,000 gallons for watering horses and streets and leakage and 1,180,000 was needed, rounded off to 1,600,000 to provide for the growth of the City. (Treadwell did not provide any extra for the fighting

of fires, assuming that at the sounding of the alarm, all other uses of the water would stop and there would be enough water available to supply eight engines which could pump it high enough to reach the top of the City's tallest building).

Having thus satisfied himself as to the amount needed, he turned to the source. If the water was to come from the Charles River, he would draw it from above the falls at Watertown, through two round wooden trunks, 2 1/2 feet in diameter buried at a sufficient depth under the earth to prevent freezing. The water would run to a pumping mill on the Mill Dam in the City. There it would be pumped up to a Reservoir on Beacon Hill, and from the Reservoir through mains of iron to all parts of the City. He estimated the mains laid on the level and constantly filled and subject to small pressure would last forty years. One pipe would be sufficient for the City's supply but by laying two, repairs to either one could be made without interrupting the supply.

The Reservoir, he stressed, was very important. Treadwell estimated 800,000 gallons would be used during five hours in the morning and 800,000 during the twelve succeeding hours. Water would be shut off from the Reservoir during the remaining seven night time hours. The average hourly use during the day would be 66,666 gallons, but at times the use would reach 160,000 gallons an hour. If the water were kept running into the reservoir during the night, the larger amounts used during peak hours would always

be available from it. If not, the 160,000 gallons would have to be taken directly from the machinery (pumping mill), which he considered a disadvantage, even if the velocity of the water would be less from the reservoir than directly from the machinery.

His reservoir would be 30,000 superficial feet, 8 feet deep with a capacity of 1,800,000 gallons when two-thirds full. That amount could be obtained by working the engines ten hours each day, during the night-time.

Treadwell now turned to Spot Pond in Stoneham, eight miles distant from the City as another possible source. Both from observation and gauging, he was easily convinced that the large amount of water available from the Charles River would be more than enough to supply the needs of the City even in the dryest years. Unable, however, because it was surrounded by bushes and meadows, to survey Spot Pond Treadwell wrote that that would have to wait until the Pond was frozen over, and relied on a previous survey of the 220 acre Pond laying 8 miles from Boston.

During the dry summer of 1822, the Pond had been drawn down eight feet to a level eight feet below the waste way to supply the mills built around its perimeter, but by the following winter, it had filled to such a degree that its water flowed over the waste way. That fact, and the estimate that 800,000 gallons daily were leaking out through the gate which could be repaired, convinced Treadwell that the supply at Spot Pond was sufficient. Yet, to make perfectly sure, he urged the Committee to direct some person to put a water measure on the Gate and let it register over a sufficient period of time.

Unlike the Charles, Spot had the advantage of gravity flow into the City and would need no pumping. The surface of the Pond two feet below the waste way was 140 feet above the level of the water in Boston Harbor at mean tide. Beacon Hill was 90 feet above the Harbor level, Spot 50 above Beacon Hill. Treadwell would bring the water in in a line of Iron pipe which would run from the South End of the Pond, 80 rods east of the Andover Turnpike, southerly, following low land to the Mystic River, cross it near the Shipyard in Medford, thence, after crossing the Middlesex Canal, keep near Craige Road from Medford to Craige's Bridge. Here it would cross the Charles River to the Boston Shore, and then up to the Reservoir on Beacon Hill. There would, under his plan, be a second reservoir on Copp's Hill, supplied from the Beacon Hill Reservoir. He also gave an alternate route, somewhat longer, but perhaps making the crossing of the Charles less difficult.

This alternate course would be more westerly. The water would flow as before out of Medford, continuing until it passed between the Powder House in Charlestown and Prospect Hill, through Cambridge Port to a point of land opposite the Mill Dam, and there crossing the Charles to the Dam where the River was comparatively shallow; over the Dam to Beacon Hill. The first route would be seven miles and 16/52s of a mile long, the second eight and one-quarter miles. There would be twenty-two miles of pipe in the streets of the City (counting mains only, not service pipes to the houses). The total cost of the works (excluding

the cost of the land for the Reservoirs and with a caution that "the expense of crossing the ((Charles)) river ((was)) not likely to be accurately estimated, as it is a work of a kind altogether new") and that the estimate did not include the cost of acquiring the Pond, would be $615,469 from Spot on the westerly route, and $558,353 on the "Craige's" route. The cost of procuring the water from the Charles would be $514,842, and included two men in constant attention to the machinery plus the capitalized cost of repairs for one year.

Treadwell attached the chemical analysis of the two waters done by Dr. Charles T. Jackson to his report. They showed both of an acceptable purity, taste and color.

What was done with the Treadwell survey was what was to be done with subsequent surveys over the years—nothing.

By 1834, calling for the introduction of a supply of pure water into the City had become a standard part of the inaugural address of each incoming Mayor. Some wished it done at the City's expense. The Capitalist wanted a private, profit making (they hoped) Corporation. Mayor Theodore Lyman (1834-1835) insisted something be done. Another survey was ordered, this time by the City's Engineer, Laommi Baldwin, whose family name is borne by the apple his father discovered. Baldwin was a lawyer and author. But his greatest prominence was as a Civil Engineer. Indeed, he is called by some, the "Father of Civil Engineering in America." His accomplishments in that field were many, Fort

Strong on Noodle's Island in Boston Harbor; the Bunker Hill Monument; the extension of Beacon Street below the Common; the great Dry Docks in Charlestown and Norfolk; the surveying of the Erie Canal. He begins his report from Charlestown on October 1st, 1834, with an unnecessary apology:

(The report is)--"far from being so full, definite, and so much in detail as the important object demands."[1] He then proceeds to submit a survey exquisite in detail which runs, with the chemical analysis of Dr. Charles T. Jackson attached, to over one hundred pages.

The well ordered mind of Baldwin required that he first list all the sources of water existant in the City. He lists four:

1. By collecting rain water in cisterns on the roofs of house, etc.

2. By raising it from wells in the common way.

3. By boring into the earth and tapping springs below--(Artesian wells).

4. By conducting it from high and distant sources by aqueducts, conduit pipes, or pumps.

The first method is in common use, he pointed out, in Boston and other places where no supply of pure water can be obtained from the earth; the second method is also common; to the third he devotes much detail, tracing the history of Artesian

1. City Document No. 12-1834.

wells from the Artois Province in France to a magnificant one he himself had built at the Norfolk Naval Yard. And as far as Aqueducts are concerned, he describes the better known ones from the Appian Aqueduct (B.C. 312) to the Agua Virgini, restored under the Pontificate of Nicholas V, and completed during the Reign of Pius IV in 1568; then details that method of supply in the Cities of Paris, London and Edinborough. On page thirty six he comes to the point reached by Treadwell on page one of his report: How much water does the City actually need each day?

First, he reasoned, he would find out how much water the City now had, at least from its major source, wells. To determine that he sent out one Eben A. Lester to make a careful investigation of all wells in the City. Baldwin found the results of the investigation very curious. (Not as curious, however, as some in later years would find the methods used by Lester in his herculean task).

Of the total of 2,767 wells Mr. Lester had located, the water was drinkable in 2,085 of them, but of the same 2,767, 2,760 were hard and not used for washing. It was easier to quench ones thirst in the City than to remain clean, it seemed.

Baldwin then estimated that the population of the City would be 80,000 by 1840. (It actually would be 84,400. This was not the first entry into the field of population estimates by Baldwin. In 1809 he published a paper warning against extensive immigration impairing the national character). If one were to take Treadwell's figure of a need of 1,600,000 gallons a day and divide the

population of 80,000 into it then the 100 gallons a day Treadwell said was the need for each person would only be 20; not enough.

Turning to potential sources, Baldwin begins by listing no less than thirteen Ponds ranging in size from Spot with 260 Acres to Morse's Pond in Needham, 20, and in distance from the City, Learnard's Pond in Framingham, 27 miles, to Baptist Pond in Newton, nine miles, (he included the Charles River) then he proceeds to shoot down all but one of his ducks.

He dismisses Treadwell's Spot Pond since his measuring of its discharge was 1.67 cubic feet per second, while in order to produce Treadwell's 1,600,000 the discharge would have to be 2.41 feet per second (and besides, of course, the 1,600,000 was now inadequate in view of the increased population.)

Some of the remaining ponds were dismissed because the supply was also inadequate; some because the water was impure and others because the route over which the aqueduct from them would have to travel was too high for gravity flow. The Charles River, although more than an adequate supply, was removed from consideration because of the analysis of its water. Some samples were taken by Jackson at the Falls at Watertown. Jackson found the water there to be impure. (A great irony. For years the River water there had been used in the manufacturing of paper and cotton cloth. The discharge of the Mills so discolored the water that the firm of Bemis and Eddy, manufacturers of a high quality paper much used for the correspondence of the well-to-do,

and for legal documents, had been forced to bring in clear water from a distance at considerable expense. Also, the factories using the water to bleach cotton found that their product, rather than been bleached white, was being taking on a reddish tint. Both early examples of the self-defeating nature of pollution).

Baldwin now turned to the more distant sources in Framingham and Natick. Long Pond, he stated, from a calculation made during surveys by the Commonwealth, was 600 acres and its surface 127.91 feet above marsh level. He found an outlet which fell into the Concord River near a Cotton factory and used the mill race just above the mill to gauge the discharge, while the machinery was in motion, August 16, 1834. Using six tests and the mean from those results, he determined the velocity of the top of the surface along the middle of the current to be 18 1/2 feet in 18 seconds. Using Dubuat's formula he found the possible discharge to be 28.89 cubic feet a second and with Prony's simpler formula: 26.35. Taking 25.00 as the mean of the two results, he calculated the discharge to be 2,160,000 cubic feet or 16,156,800 gallons in 24 hours. Thus, he concluded, this source was sufficient for a supply, but held off judgment as to whether it should be the supply because of its height and relative expense of effecting a discharge from it. He then turned to nearby Farm and Shakum Ponds in Framingham. If they could not offer the needed supply, he would recommend Long.

He found Farm Pond 196 acres and 149.37 feet above marsh, 21.46 higher than Long and Shakum. Shakum, which had the appearance and the character of being a collection of clean, pure springs(but which had not been analyzed), he found to be 89 acres in size and 155.00 feet above the marsh level, 5.64 above Far and 27.10 higher than Long. He could not measure the discharge from Shakum since the outlet had been stopped up to allow farmers to get their hay from the extensive meadows below. Farm Pond and Shakum together, with springs indicated everywhere for several miles, would offer a sufficient supply. But, he added, "Long Pond is abundant, though the excavation will be deeper."

His final conclusion as to the source was that the most eligible was a combination of Farm and Shakum, together with incidental streams dependent upon them, and on Long Pond and suggested that the water be brought in by an aqueduct, without the use of pipes, to the nearest point of sufficient height in the City to allow it to flow through cast-iron pipes to the highest land in the City.

For that purpose, he proposed to build a reservoir near the road "leading from Roxbury to the Brush Hill Turnpike, by the rocks on the west side of the road north of R. G. Amory's house, or someplace in that neighborhood."[1] His reservoir would

1. City Document 12-1834.

be such that when full, the surface of the water would be 110 feet above marsh level. The aqueduct would bring the water to the Reservoir by gravity, and be capable of delivering five million gallons a day, should that amount be required, but could be easily restricted to a lesser amount. The distance from Farm Pond to the proposed reservoir was 23 and 3/4 miles and from the south end of Long Pond, through Dug Pond to the same point, 21 miles and 3/4; from the East side of Long Pond, nearly 22 miles.

As to the form of the proposed aqueduct, he began his usual thorough discussion of the subject and came to an innovative decision. There are four forms of Aqueducts, he said. The first is an open canal, like a common navigable canal, but on a smaller scale. Such an aqueduct has supplied parts of London with water for two centuries. But only its inexpensiveness recommended it if the water were going to be used for any other purpose but domestic use (washing, cleaning but not drinking).

The second was like the first, but with stone walls four or five feet high, thus protecting the canal from filling and choking by the bank's washing in, and lessening the encroachment of weeds and aquatic plants along the border. The next type of construction would be to lay stone walls up on each side without mortar or cement, two or three feet apart, three or four feet high, with flat stones to cover the top, and each laid over the whole, so to effectually conceal the works from sight, and to protect it from mischief.

The fourth type of aqueduct would go beyond the third in construction, being built in regular masonary, laid in hydraulic cement, or in common mortar, and lined with cement. The bottom would be of stone, the top covered with the same and the whole work laid underground, or where the foundation would be too low, covered with an embankment. A construction, which taken in toto, was unique at that time.

Baldwin then went with some detail into the forms of aqueducts he had previously outlined, showing in each the area of cross section, the slope in inches to the mile, the velocity of discharge a second in cubic feet and the same each twenty-four hours. He calculated the cost of the open canal at 15 cents the cubic yard or $2,288 a mile; and the open canal with sides of stone to be $7,746 per mile if it were to be five feet wide and three deep. The excavation would have to be six feet deep and eleven feet wide. He then points out that such an open canal will be exposed to frost and ice which will cover it in winter, lessening the discharge about one quarter.

All in all he lists and describes seven possible kinds of aqueducts (three merely variations in dimensions) and comes at the end to the type he obviously favors, the completely enclosed aqueduct of stone and hydraulic cement or masonary. He points out that in order to deliver 5,000,000 gallons daily* the aqueduct

*Baldwin took Treadwell's 100 gallons a day, multiplied it by his projected population of 40,000 and added an additional 1,000,000 gallons a day for future growth of the City and non-domestic uses.

should be two feet wide and four feet deep, a cross section of eight feet. Ironically, despite his statement that "a close stone aqueduct---is the most proper construction.", he would begin the line of the works, which he divides into eight sections, with an open canal for the first three miles.

Farm Pond, he notes, is 149.3755 above the marsh and 39.375 above the basin in Roxbury, and 2 feet 11 inches above Sudbury River on the North, into which it has a natural outlet. By digging 5 or 6 feet deep for about a mile or a mile and a half, the whole of the Sudbury River, with all its rain, may be intercepted and conducted through Farm Pond to the Charles, instead of pursuing its natural course to the Concord, thus making those waters available.

His canal would take the water from the Pond a distance of three miles to the left bank of the Charles River in South Natick and terminate at the commencement of the low ground and meadow separating the main from Dedham Island, a total distance of 13 miles, 7 quarters and 93 rods. Here the water would enter that part of the aqueduct, constructed on the bank of the Charles River. The aqueduct would cross the river to its right branch on a bridge with two arches of 50 feet span and 20 width. The point of crossing would be the old abutments of a bridge, now removed, a few rods below the present bridge at Spring Street to Dedham.

The aqueduct would then run east of Spring Street to the Meeting House, crossing the Dedham Turnpike to the east of the

Halfway House, and then to the Providence Road. It would pass over the Boston and Providence railroad on a bridge with two accommodation bridges. The remaining distance to where he found ground suitable for a basin or reservior was two miles, 3 quarters and 55 rods. He found it difficult to estimate the cost of this section, since the land was broken and much of it Brescia ledge (Roxbury pudding stone). He brought his line to T. K. Jones' or the Grove Hall in Dorchester and mentioned that adjacent lands admitted of even a higher line and the aqueduct and reservoir might be advanced a half mile further toward Boston.

From the reservoir to the State House (the floor of the State House was used in every report as the height to which the water should flow since this point was higher than any other in the City), the distance would be 2 miles, 3 quarters and 12 rods. The fall from the top of the Reservoir to the floor of the building would be 14 feet, and a pipe of 18 inches in diameter would discharge, at that level, upwards of 2 million gallons daily; a similar pipe would discharge into a Reservoir at Washington Square at Fort Hill, a little less than four millions of gallons.

The cost of the canal and aqueduct to bring the water to the basin or reservoir in Roxbury would be $500,000 and to bring it into the City and to the reservoir at either the State House or Washington Square at Fort Hill, would be an additional $250,000.00. This cost did not include the cost of right of ways or the purchase of the Ponds suggested as the supply. Baldwin

added a final caution as was his wont. Should any doubt exist that Farm and Shakum Ponds, with their numerous Springs were sufficient for the supply he envisioned, there was always the waters of Long Pond which could be had for between only 20 and 30 thousand dollars in addition.

Chapter III

As nothing had become of Treadwell's 1825 report, nothing was to become of Baldwin's of 1834. The question of bringing in to the City an adequate supply of pure water was far from dead, however. One could run for Alderman or City Council taking one side or the other in the controversy; a call for Water seemed institutionalized in almost every new Mayor's inaugural address. The protagonists formed several sides. Those who wanted the water brought in by the City; those who wanted it brought it, but by Capitalist. Those who wished a lot, those who felt a little was enough, those who saw no need at all. The Water Party was fragmented and thus unable to prevail. But neither did their opponents have the strength to be rid of the scheme.

On January 14, 1836, Mayor Armstrong forwarded to Engineer R. H. Eddy, instructions from the Joint Committee for the Introduction of a Supply of Pure Water into the City, requesting that he make a survey as to how that could be accomplished. The directive restricted Eddy's investigation to the Horn and other Ponds emptying into Mystic Pond in Medford and to Spy and Fresh Ponds in Cambridge. A subsequent letter on April 21st, expanded the potential sources to be considered to the waters of Spot and Mystic Ponds. An interesting expansion of Eddy's mandate in light of subsequent events.

Mr. Eddy begins his report gently protesting that he had entered on his task with much delicacy, since he supposed it had met with such thoroughness by Mr. Treadwell and his esteemed friend, Mr. Baldwin. He then, like Baldwin before him, apologizes for the little time he was able to devote to the report. Neither his report nor his defense of it in future years were to suffer from any delicacy or apology.

Eddy first sets down an economic principal, which was to become the basis for upcoming debates. If, he reasons, we build a Works of sufficient size to provide for a great future need when the City has grown, we are misusing capital, for the income from the beginning will only be in proportion to the use of the Works, and the interest on the unused pipes, pumps and paraphenalia will soon exceed the principal necessary to construct them. Thus having opted for economic caution, he proceeds to sources.

Eddy dismisses rivers rather summarily, pointing out that Lakes and Ponds are fed by pure springs, but Rivers are used to dump the unused product of mills, dye houses, cotton mills and other factories. Besides, he states in contradiction to both Treadwell and Baldwin, there is not enough water in the dry season in the Charles River. Nor in the Neponset he adds.

He reverts to economics to dismiss Baldwin's Farm, Shakum and Long, pointing out that these bodies empty into the Concord River from which is taken the water for many mills - Brown's, the Framingham Carpet Factory, Saxonville Factory in Saxonville Village etc., - and if the City were to use the Ponds recommended by Baldwin, it would become engaged in long and expensive

litigation for damage brought by the owners.

He then, seemingly out of order, points out that since the introduction of Anthracite, eliminating the use of pine wood for fuel, the cost of steam power is down (two shillings per horse power, per an eleven or twelve hour day) and when the price per ton of the coal is down to $8.00 the ton, one would be able to have 50 horse power per the twelve hour day for only $15.50. Thus he concludes, by the use of machinery, the City could be supplied with an abundance of pure soft water from resources with five miles in any quantity which may ever be wanted.

He lists seven potential sources - Spot Pond in Stoneham, 260 acres; Horn in Woburn, 102.83 acres; Edge in Woburn, 20.63; Winter and Little in the same Town in combination, 19.07 acres; Mystic in Medford, 227.89 acres; Spy and Little in West Cambridge and in combination, 140.57; and Free, Cambridge, 180.57. Eddy points out that since three of the Ponds discharge into Symmes River which in turn discharges into Mystic Pond and Fresh and Spy run into Alewife Brook, which discharges into the Mystic Pond outlet, by raising a dam where the Middlesex Canal crosses the Mystic River, the waters of all the Ponds might be united. But the results of his survey indicated that the quantity of water in the Mystic Pond as it stands alone is so great as never to render it necessary to resort to either (sic) of the others.

Eddy compliments Treadwell's prudence in estimating the supply available at Spot Pond, i.e., enough to give the City 1,600,000 gallons a day, but his own estimates of the capacity of the Pond with the sixty additional acres he would add by damming, he felt that indicated the Pond could provide, on the average, 2,500,000 to 3,000,000 gallons a day.

As the season was unfavorable to gauge the quantity of water wasted from the Mystic Pond, he relied on the testimony of Mr. T. F. Mayhew who had resided at Bacon's Mills for many years. Mayhew said that in the Spring Freshets when the water was highest, the head was about 8 feet; that is two feet above the top of a six foot dam, 20 feet long. When the Springs are lowest in the summer or autumn, two gates, each one foot square, will reduce the head of water, in 12 or 14 hours, to about four feet; two feet below the top of the dam, but that is not frequently the case for any length of time. Two gates under that circumstances would deliver about 20 cubic feet per second. He reckoned from this and other information that the Pond received, in dry seasons, 40 cubic feet, or 300 gallons per second, equivalent to 121,961,000 gallons per day, enough for the Mystic to supply any quantity the City might ever require.

Eddy went on to develop a rather unique scheme, one which would become controversial, and aspects of which he would be forced to continually defend. He would initially use the waters of Mystic, and when needed, Mystic and Spot.

An examination of a map of Boston, Eddy said, would indicate that one fifth of the City lay above a horizontal plane, 20 feet above the highest tides, and the remaining four fifths below that plane. The portion above the plane he designated high service, the portion below low service. He continued that since that portion of the City in the high service area was much developed, most of the future growth of the City would be in low service portion which he assumed would always be occupied by "tradesmen, mechanics, artisans, and a portion of the community devoted to manufacturing pursuits."[1] Consumption thus would be much greater in low service than high, which he assumed would not in any future period exceed 1,000,000 gallons a day.

He then fixed the height the water should be raised for the low service to 60 feet above highest tides or 40 feet above the divisional plane. The expense of raising one million gallons 60 feet over a twenty hour day - (the other four hours to be taken up in oiling and repairing the machinery), since it would take 16 horse power and the rate per horse power was 33 cents, for 11 hours, and the fuel would cost 60 cents for 20 hours would be $9.60 per day.

Eddy then illustrates the economic feasability of raising one, two and three million gallons a day for the low service from Mystic Pond. Allowing each tenant the generous amount of

1. Boston City Document No. 10-1834.

200 gallons a day (average usage in Philadelphia was 187 gallons and in London 180 gallons), and charging each $5.50 a year as the water rent, he computes the total rents at each level of supply and the cost to raise it assuming coal to cost $8 dollars a ton, then he translates those figures into the capital required at 6% interest. Adding to those figures the cost of building the Works from Mystic Pond to the City will give the total expense of the amount of supply agreed on for his low service, he writes.

As to the mode of bringing water from Spot Pond into his high service, Eddy notes that the terrain around Spot Pond is extremely hilly and abounds in ravines. Pointing out that the Mountain Brook branches off into two valleys, one running east and the other west, and the eastern branch runs nearly to Spot Pond, he recommends the raising of a dam across the valley at the branches of Mountain Brook, thus creating an immense addition to the Pond to where the Brook cuts into the valleys. This scheme would add 60 acres to the Pond and the evaporation from this natural reservoir would be replaced by the water of the brook.

Eddy would run a conduit from the dam he proposed to build, to the Andover Turnpike, through the Turnpike, then follow the general direction of the Brook, along the low ground to Mystic River, a short distance below the bridge at Medford. Crossing the stream there, it would curve south to the Medford Turnpike, until it crossed the Middlesex Canal at the Toll House

of the Turnpike. From there the line would proceed in the road to the foot of Bunker Hill Street and then up to a Reservoir on the Summit of Bunker Hill. Since the Reservoir on the top of the Hill would be 98.961 feet above the coping of the Dry Dock in the Navy Yard, and Spot Pond, at the surface of the water, was 138.161 above the same mark, the fall from the Pond to the Reservoir would be 40 feet. Because he intended to make a Reservoir out of the whole of the Pond and draw it down as much as eight feet if necessary, he listed some of the depths below the level of the Pond of some principal points in the City ranging from the floor of the State House 30.261 feet below to the upper step of Purchase Street Meeting House--82.801, thus illustrating that there would be no place in the City the water from his high service would not be available. (The figures he used in this calculation were first given by Baldwin in a report to the Jamaica Pond Aqueduct Company. At the time of his 1834 Survey, Baldwin was Engineer for both the City and the Aqueduct Corporation).

Somewhat abandoning his exortations about the economic uncertainties of building a Work to supply more water than will be immediately taken, Eddy advocates a pipe not only large enough to guarantee the delivery of two to two and one half millions of gallons a day, but one that would be capable of delivering four million. The distance from the Pond to the Reservoir would be exactly five miles, and using Prony's formula, he concludes that the pipe should be 22 inches in diameter. To get the water from

the Town of Charlestown to the City of Boston, he would lay two mains, each 18 inches in diameter, through Eden and Main Streets, to the Warren Bridge, and cross that Bridge to the City. The reason given for his choice of two pipes is interesting and based on a letter he had received from the Superintendent of the Philadelphia Water Works, Mr. J. F. Graff, Esquire.

"Mr. Walker of London" (Graff writes) calculated that under a head of 56 feet from our reservior to the summit of our city, 8,000,000 gallons would flow through a 20 inch main in 24 hours. No doubt this result would take place, if the pipes was allowed to be open the whole time, and the flow be constant for the 24 hours; but this is not the case with water works where the water only gains an increase of velocity in the pipes in proportion to the quantity used".[1]

Graff goes on to explain that he has seen instances where the water when first turned on to fire hoses was very tardy, three hoses being needed to supply one engine when the water first came, but one proved sufficient after the water in the main gained its speed. Graff also states that the calculations and formulas fail because they fail to take the useage at any various amounts of particular time into consideration. Often, he says, when the use in London is 4,000,000 the main calculated to produce 8,000,000 gallons fails. To obviate the difficulty,

1. Boston City Document No. 10-1834

an additional main of 20 inches was laid. Graff also warns against trying to save money in laying too small pipes from the one main.

"This is generally done," wrote the Superintendent, "by mistaken calculations that if a main be 40 inches, four branch pipes of ten inches each must be sufficient, as they are equal in area to the main, when perhaps to these latter pipes of 10 inches, there may be 40 or 50 lateral pipes attached of double the area of the main."[1] Large feeds from the main to the distant lateral pipes should be used, he cautions.*

Anticipating an objection, Eddy turned his attention to the fact that at extreme high tides, salt water slightly affects the water of Mystic Pond at its lower extremity. His solution would be to raise a dam at the outlet, preventing the admixture of fresh and salt water. He also noted that Dr. Jackson's analysis of the water at the outlet of the Mystic Pond showed that 27.397 grains yielded one grain of solid matter, while the same amount was yielded by 41.666 at Spot Pond, 16.826 at the Croton River (New York City's source) and 6.666 grains in the Verulam and Wandle Rivers in London.

*Graff, who built the Philadelphia Water Works and was its Superintendent until his death, was quite helpful to the City of Boston during the years it spent examining the possibility of a supply of pure water and while Eddy was pleased to quote him in Eddy's 1836 report, a subsequent quote of Graff's - "if you can get the water without machinery, I urge you to do so.", was telling against Eddy's plan to pump the water.

1. Ibid.

(The ubiquitous Dr. Charles T. Jackson had done the water analysis for Baldwin in both his survey for the Jamaica Pond Aqueduct Company and for the City; for Treadwell in his report and now for Eddy. A man of considerable brilliance and controversy, Dr. Jackson received his preparation for Harvard Medical School with Doctors James Jackson ((one of the School's founders)) and theequally eminent Walter Channing. He received his M.D. from Harvard Medical in 1828 having won the Boylston prize for his Dissertation. Jackson developed an interest in mineralogy and went to Paris the year of his graduation to study medicine at the Sorbonne and geology and mineralogy at the Ecole Des Mines.)

(Always a man of expanding interests, he secured, while in Europe, a large number of electrical instruments and apparatus. On the ship carrying him home, he became friendly with Samuel F. B. Morse who shared his interest in such equipment. When Morse announced his invention of the electric telegraph, Jackson claimed to have pointed out to Morse the underlying principles of such a device which he had previously perfected in a working model, but then abandoned as having no commercial value. Jackson later claimed to have invented guncotton when its discovery was announced by F. Schonbeing).

(But his most noteworthy controversy was his insistance that it was he, not W. T. G. Morton who had determined that ether would cause unconsciousness to such an extent that it could be used safely in human surgury. It is known that Jackson had a

working model of a device quite similar to Morse's telegraph, but he discarded it. It was also known that he had given ether to Dentist Morton to use on a patient during the extraction of a tooth. But the anesthetic properties of ether were already known to science, and if the experiment had proven fatal, and there was no certainty that it would not, Jackson probably would have been the first to condemn Morton.)

(Despite a lifetime of controversy ((insanity overcame him in 1873)). Dr. Jackson was recognized as a brilliant geologist and mineralogist, being geologist for most of the States of New England).

Eddy's dam at Spot Pond would increase its acreage from 227.89 to 857.89. His route for the water from Spot would commence at the dam near the road to West Cambridge; run to the Mystic Pond outlet West of the Middlesex Canal, cross these waters in iron pipes under the bed of the stream, then to the Middlesex Canal, through it, and under the Lowell Road. Continuing parallel with the Canal, it would cross the Medford Road to Winter Hill, enter the Medford Turnpike at the foot of the locks of the Branch Canal from Middlesex to Medford River, then to Main Street in Charlestown, curving around the Base of Bunker Hill to the well of the steam engine house on a wharf proposed to be built at that point. The distance would be 26,500 feet. The construction of the conduit would be brick masonry, laid in hydraulic cement, three feet in diameter.

The genius of Eddy's plan was this. He was, in effect proposing two water works. One was an aqueduct to bring water from Spot Pond by gravity to a Reservoir (he called it the "upper") on Bunker Hill. The other an aqueduct to bring water from the Mystic Pond to the foot of Bunker Hill and then pump it up to a second (the "lower") Reservoir on the Hill's summit.

The water from the upper (Spot Pond) Reservoir would supply low service, those buildings below the imaginary plane Eddy had drawn on the map of Boston. The lower (Mystic Pond) Reservoir would service the high service, those buildings above the plane. This was possible, of course, because the water of the low surfaced Mystic Pond now flowed from a Reservoir on Bunker Hill sufficient in elevation to permit the necessary head.

Eddy reasoned that only one service would be needed immediately. He would cause the waters of Spot Pond to flow into the Mystic Pond and have the water from that supply pumped up to the Reservoir on Bunker Hill, flowing out of it to the main pipe of the high service, and by a connecting pipe, to the main for the low service also.

When the demand had outstripped the supply from Mystic, or when the dryness of the season prevented the water from Long Pond flowing into the Mystic, he would cause the water from Long Pond, now stopped at the Reservoir on Bunker Hill, to flow into the low service main.

Confusion arose as to why he did not do it the other way 'round, since the Spot water could supply the high service through

gravity. Upon reflection, it can be seen that it made no difference, since machinery would have to be used to pump the Mystic water. The use of machinery - pumps and engines - of which Eddy would passionately defend in later years, was finally the undoing of his plan, put to death by his friend Mr. Graff's aversion to pumping. Perhaps Eddy sensed that an objection would arise to his use of pumps, for after listing the estimated expenses of the project, he spends considerable time at the conclusion of his report giving examples of pumps and engines used successfully in both the London and Philadelphia works, and mines in England and Wales.

Eddy's estimate of cost, without considering pipes for distribution in the City, would be $388,747.76 from Spot Pond and $218,130.00 from Mystic, a total (which he did not choose to add up) of $606,077.76. Less than Treadwell for much more water, and much less than Baldwin for the same amount.

(Eddy had the foresight to inquire of Mr. George Odiorne, who claimed to have the title to Spot Pond, on which he and the others operated mills. Mr. Odiorne traced the title back to an unconditional grant of the General Court of Massachusetts Bay in 1640, and then recounted a running battle between the mill owners and abbuters for many years. The first mill, a corn mill, was erected the same year as the grant - 1640. At that time, Stoneham was a part of the Town of Charlestown).

While Mr. Eddy was busily at work determining that the water should come from Mystic and Spot, a group of enterprising gentlemen,

William Sullivan, Daniel P. Parker, Caleb Eddy, and others, went to the Legislature and, in one day, April 16, 1836, had passed in the House, passed in the Senate, approved by the Governor's Council and signed by Governor Edward Everett, an act incorporating the Boston Hydraulic Corporation for the purpose of supplying water to the City. Beside the expected clauses, i.e., authority to take land, water to the City for fighting fires, there were several interesting additions. One would give the City the right to purchase one third of the shares of the Corporation, or all of them upon completion of the Works if it so desired, provided the price would return the investors a profit of ten percent. Fireplugs (hydrants) would be built into the system, but the City would have to pay for the water used as it would have to pay for that used in the two ornamental fountains the Corporation proposed to build. There was also a clause requiring a vote of the Citizens of the City accepting the provisions of the Act. The vote would have to take place after the City Council itself had accepted the proposals contained in the legislation, and within four months of the effective date of the Act, or the Company's Charter would expire. There was no doubt as the source the Hydraulic Corporation would look to. It's Charter restricted it to bringing the water in from "within ten miles North of the mouth of the Charles River" - Spot Pond.

It seemed now, for the first time since Mayor Quincy's call for water, all elements necessary to heed that call were

present. Three extensive reports and surveys were in the hands of the City Council's Committee on Water, each done by a distinguished engineer and two agreeing on Spot Pond as the best source; a vehicle existed to carry the work through in the Boston Hydraulic Company; and a compromise between the Capitalist and those who wanted the City to do it by means of the Act which created the company allowing City participation or eventual ownership. And a growing and more recognizable need for the water.

The City Council did not, as required to let it to continue to exist, act upon the Boston Hydraulic Company by the prescribed date, August 16, 1836. The forces who favored the City bringing in the Water at its own expense, called for a meeting of the inhabitants of the City for the 26th of August at Faneuil Hall. Over two thousand packed the Cradle of Liberty where so much of the History of Boston had been made. The debate was acrimonious, with much shouting, challenging of facts and figures, shoving and hissing. The question to be voted up or down was: "It is expedient for the City to bring in a supply of pure soft water at its own expense" the vote , 2,107 yeas and 135 nays. Having thus dedided by whom one would have hoped that they then would have addressed the question of from where, but they did not.

On December 19, 1836, the Common Council met and noted the results of the vote, stating that in order to carry it out, the City would have to petition the Legislature for the necessary authority. That was not done subsequent to the Public Meeting, they said, since the Legislature was not then in session, the

next session to be on January 1, 1837. They alluded to the fact that the Jamaica Pond Aqueduct Corporation had Baldwin do a survey which indicated that the Jamaica Pond could provide up to ten times the amount of water it now did; but if the City was to go ahead with its own works, the proprietors would offer the Corporation for sale to the City.

Evidently feeling the rising tide of criticism, the Council pointed out how diligently they had been in identifying the potential sources of water; the Ponds at Framingham, the Spot, Jamaica Pond. When they made a decision, they claimed, "there will doubtless be general contentment among the people."[1] They caused a survey, and many researches and inquiries, they protested, and, "whatever of delay may seem to have attented their operations, they know that nothing savouring of negligence is justly charged". They then concluded by referring the whole subject to the next City Council, which, in its own turn, passed an order on January 5th, 1837, to appoint a "suitable number of Commissioners"[2] to look into the whole matter.

The water just would not flow.

1. Boston City Document 7-1836.
2. Ibid.

Chapter IV

Although the argument would be raised again, the vote at Fanueil Hall had effectively ended the possibility that the water would be brought in by a private company. The sticking points now were from where, and to a lesser extent as the years passed and the City grew, how much.

There could be no compromise as to source, the water could only come from one. But there could be compromise as to who was going to make that decision, and the names of the three water Commissioners appointed on March 16, 1837, spoke of that compromise.

Daniel Treadwell who first suggested Spot Pond and who was for a lesser amount; James F. Baldwin who favored a large amount brought from Farm and Shakum and perhaps Long, and brother of the ailing Laommi; and, the one to be persuaded by one or the other,Nathan Hale.

One of the City's most prominent men of the day, Nathan Hale, nephew of the Revolutionary war hero, earned his A.B. from Williams College and an A.M. from Dartmouth, and was admitted to the Suffolk Bar in 1810. But he soon abandoned the legal profession for journalism, and purchased the Boston Daily Advertiser, the first daily newspaper in Boston. He used his newspaper as a means of swaying public opinion and was one of the first American editors to introduce editorial comment as a

regular feature. Hale held a high place in the history of the American Railroad System and was a founder and first President of the Boston and Worcester Railroad. Also a founder of the North American Review, his stereotype maps of New England became a standard geographical reference.

The Commissioners were to be paid $8.00 each day they met.

About this time, someone got around to asking how the project would be paid for. A Committee was appointed to look into the matter. The first paragraph of their report is worthy of quote, just for its language.

"The Committee entered upon the performance of the duties devolving on them with a degree of diffidence which the importance and magnitude of the subject referred to them seemed naturally to inspire. And while they regretted that the subjects embraced in the order had not been referred to the Committee of Finance, whose particular province it is to direct the financial operations of the City, and to recommend from time to time, such measures as they may deem expedient; to facilitate them, they felt bound by a high sense of duty to consider, somewhat in detail and to the extent, they were enabled to, from the time which they could devote to the subject and the sources of information which were open to them, the subject matter which had been referred to them."[1]

1. Boston City Document No. 9 - 1837.

They reported:

1. That the project was so worthy, the City ought to borrow the money.

2. They couldn't because of the state of financial affairs both here and in Europe.

3. In a year things would be better and they could borrow the money at low rates without recourse to a foreign source.

4. That the City owned enough property, aside from public buildings for collateral.

5. Although the City debt had risen from $100,000 at the inception of its Charter, to one million five hundred at present, not to worry, it had enough property** to liquidate the debt and leave a handsome balance.

6. That the City advance the money initially needed for the project, repaying itself by the sale of land and that the same procedure be used for paying the interest on the money that would be borrowed as needed.

On December 8, 1837, the Commissioners were to produce a 63 page plan for the supplying of the City with pure water. Only Hale and Treadwell would sign it, Baldwin refused.

**The City owned much land which it sold as the City and the demand for land grew.

Going back once again over the familiar (to anyone who read the previous reports) ground, they first compared the supply provided the citizens of London (measured in wine gallons)* and Philadelphia (significantly measured in beer gallons). They concluded that in five years the City would need 2,500,000 gallons and 3,000,000 in ten. Now the need was for 1,600,000. (Treadwell prevailed here, somewhat unscientifically one would presume since it had been twelve years since he first proposed that amount and the City's population certainly had shown great growth).

Lining up eighteen of the usual ducks, they began as before, to knock over the ponds. Some for being too distant, some for lack of supply. They ended up with seven Ponds and two Rivers and then used the analysis of the by now water logged Dr. Jackson to further refine their list.

Dr. Jackson disappointed them by declaring all the prospective sources nearly pure. "Chemical analyses," they countered, "however, is not yet sufficiently perfect to determine several important qualities of the foreign substances found in water". They would form their own opinion by taste and color. In order of clarity, they concluded were the following candidates: Spot, Long, Punkapaug Pond, Mystic, Charles River and the Neponset River. But there was no marked differences in taste, all being nearly insipid.

*A wine gallon is equivilent to the United States four quart gallon - 231 cubic inches. A beer gallon, used in some of the surveys and reports, equalled 282 cubic inches.

Since the structure necessary to bring the water in from Punkapaug would be as expensive as that from Long and Long had more water, Punkapaug was out. Neponset lost out to the Charles because, although they were the same in distance, the Charles water was more colorless. Of the four finalists,Spot and Long were to be preferred if the water were to be brought in without artificial means, and Mystic and the Charles River, if it were.

They then proceed to go through the by now familiar examination of all aspects of each; distance; area of water, height over marsh, head; available supply. They list the finalist, not in order of preference it turns out, as five possible plans.

1. Pump the water from the Charles River to a Reservoir on Corey's Hill in Brookline, 117 feet above tide water in Boston, and bring it into the City in an iron pipe.

2. Pump it from the Mystic Pond to a Reservoir on Walnut Tree Hill near the Royal Farm in Medford, through Cambridge to Boston.

3. Bring the water from Spot Pond to the reservoir on Walnut Tree Hill in Medford in conjunction with a plan to pump water in from Mystic Pond if the quantity from Spot falters, thence into Boston by iron pipe.

4. Bring the water in from Long Pond by a closed conduit to the proposed Reservoir on Corey's Hill in Brookline, then into the City by iron pipe.

The Commissioners apologize that the amount of time they were forced to spend on the Long Pond plan, prevented them from

making the estimates for the other three plans as accurately as they would have liked, but they were, they said, sufficiently near the truth to be relied on.

The water from the Charles would be pumped up near the falls in Watertown, forced through a 21 inch pipe to the Reservoir on Corey's Hill, which would hold 5,000,000 gallons, two days of the supply needed in future, which would allow for breakdowns and repair of the equipment and other interruptions. From that Reservoir, the water would be taken by an iron pipe 21 1/2 inches in diameter to a Reservoir to be built on the Bowdain estate on Beacon Hill. Using, as before,Prony's formula, they estimated the discharge on the Hill would be 4 cubic feet per second, or 2,592,000 gallons a day. Whole cost of the works: $465,039.00.

Then, by rather strange logic, they established a premise, which would prove to be a flaw in their plan for raising the needed water by pumping it. Since, they said, they knew of no Engine in use in America that produced the same results as the so called Cornish engines in use at the mines in Cornwall, they would use the results of that engine to determine how much coal would be needed to claim the amount of water needed. They established a formula. What amount of coal would be necessary to raise one pound of water one foot? Calling the result the Engines' "duty", they used as an example the most efficient of the Cornish Engines. The results of those Engines ranged from as low as 22,000,000 pounds one foot with one bushel of coal to a high of 91,959,596 with a bushel. They settled on 60,000,000 pounds one

foot with one bushel of coal. With the then cost of coal, that would amount to $11,808 annually, which they capitalized at 5% to be $236,160. Thus the total cost for the water from the Charles would be $701,199 plus the usual 10% for contingencies or $771,318.

From the Mystic Pond they would bring the water to a Reservoir on the top of Walnut Tree Hill, at an elevation of 126 feet above tide water, 1.562 miles from the source. The Reservoir, like the one proposed for Corey's Hill, would hold two days' supply, 5,000,000 gallons. From that point it would be brought, in an iron pipe of 22 inches, through Cambridge, west of the colleges, to Charles River, which it would cross on a permanent stone bridge, constructed on the side of the existing bridge between Cambridge and Brighton, cross the Mill Dam to the Reservoir on Beacon Hill. The whole distance would be 7.52 miles and cost $554,622. Add in the aforementioned cost of pumping and the 10% contingency allowance, the cost totaled $869,860.

As far as Spot Pond was concerned, they were convinced that that source would yield 2,100,000 gallons a day, never less than 1,600,000, which, they said, was the amount which would be needed for the next four years. Then, they supposed, the populations of the City would have grown to 87,000, necessitating a supply of 2,500,000 and, if the population continued to grow at the assumed rate, it would be 105,000* at the end of another six

*They could not, of course, have anticipated the flood of immigrants that were soon to come.

years, requiring 3,000,000 gallons a day. Following Eddy's reasoning, they averaged out the daily need over those periods to be 2,750,000, 2,100,000 from Spot and an additional 650,000 a day from Mystic. The Commissioners would construct the Works from the Mystic to a degree that it alone could supply the daily need if Spot Pond should fail during years of drought.

The water from Spot would come in a 22 inch iron pipe starting at the southern end of the Pond east of the Andover Turnpike, to Mystic River, above the upper shipyard, cross the river on a permanent stone bridge, to the Reservoir on Walnut Tree Hill, a total distance from the Pond of 3.18 miles. From the Reservoir in iron pipes of the same diameter, 22 inches, it would follow the same plan as the route of the Mystic water, across the Charles, over the Mill dam and up to the Reservoir on Beacon Hill.

Here they hesitated, for they were unsure of what the City would have to pay to acquire the rights to Spot Pond. They asked the owner.

Mr. George Odine's reply was rather uncivil. He protested, quite strongly, that he and his brother Thomas of Malden, were the sole owners of the Pond and of the bed of the creek leading from it to the Mills in Malden. The property also included a mansion house, barn, out buildings, a rolling and splitting mill, machine shop etc. Since the City had, for so many years, been dawdling along unable to make up its mind as to where its water was to come from, if indeed it ever was to come, they had hesitated to expand or improve their holdings. But, if the City could

make up its mind by September 1st next, they could have one moiety of the Pond for $65,000 but if they continued their procrastination, it would cost them $70,000 until the first day of January, 1838. In calculating the price, Mr. Odiorne, noted that it included the value of an exceptionally large daily supply; and a consideration of the fact that it would put him out of a business he had been engaged in for 30 years and had hoped to leave to his son.

Too much, the Commissioners concluded, $60,000 would be more than generous. Thus the cost of getting the water from a combination of Spot and Mystic Ponds, including the pumping and 10% for contingencies, would be $850,006.

As to Long Pond, its distance from the City, 18 miles combined with its limited elevation, would make bringing in its water directly to the City by iron pipe too expensive, so they looked to an aqueduct, along the straightest line from the Pond to a Reservoir on Corey's Hill in Brookline. The conduit, of brick or stone, would be closed, thus eliminating the possibility of it being contaminated by bathers or by substances thrown into it by the residences along its banks.

The Commissioners offered two possible constructions. One, a close conduit of stone, consisting of a floor nine feet wide and one foot thick; upon this two walls would be placed 2 1/2 feet high and 1 1/2 feet thick; leaving a clear space of 4 feet between them. This water-course would be covered by a semicircular arch 1 1/2 feet thick, the whole being of rough stone without cement, designed to be surrounded with a puddle of clay and gravel to prevent leakage.

The second would be laid in hydraulic cement and designed in the form of a cylinder, 8 inches thick, having a clear passage for the water, of 4.6 feet in diameter. Both structures, of equal areas were calculated to convey the water at a slope of 3 inches to the mile; and deliver 11 cubic feet per second.

The plan was quite elaborate. The Water from Long Pond spilled into the Concord River, which supplied the Middlesex Canal. Thus any dimunation in the supply would affect Mills as far away as Billerica and Lowell. The Commissioners assumed that that would not be a problem, the supply was so large, except in dry season. Nevertheless, they proposed to form two Reservoirs from several small Ponds in the vicinity of the Concord River, where water might be reserved in winter and used as required in dry seasons. They disbelieved, as they did Odiorne's, the estimate of the damages by the Mill owners, and used their own. To bring the water from Natick, through Needham and Newton, where it would cross the Charles near the Lower Falls, then to Brighton, terminating at the Reservoir at Corey's Hill, and thence, in a pipe 21 1/4 inches to the Beacon Hill Reservoir. Thus the estimated cost for the four proposals, including the ever present 10% for contingencies, were:

1st plan	- Charles River	$ 771,318
2nd plan	- Mystic Pond	$ 869,860
3rd plan	- Spot and Mystic	$ 850,006
4th plan	- Long Pond	$1,118,294

Now the elimination. Since the 2nd plan was certainly not superior to the 3rd, and it would cost more, that was not the plan to be adopted. By adopting the 1st plan in preference to the 3rd, a savings of $80,000 would be achieved, but as this plan (Charles) required machinery "which implies some shade of uncertainty"[1] (although they were convinced, since they had recommended two machines either of which could pump up the necessary supply by itself made the uncertainty almost non-existent) out went that plan.

Long and Spot-Mystic were left for consideration. Noting that the Long Pond scheme would cost $268,288 more than Spot-Mystic, they nevertheless pointed out that Long had the advantage of being able to supply a large surplus of water to the Reservoir at Corey Hill which would be available at a future day, by laying a new main from the Reservoir to Beacon Hill when needed. They then proceeded to do in the Long Pond plan arithmatically.

The extra supply available from Long Pond would not be needed for ten years, and then require the laying of a second main from Corey Hill to Boston. If they took the extra present cost to build the works from Long Pond, and capitalized it at 5% interest for ten years, and added in the cost of the new main, and compared these figures with the cost of increasing the works at Mystic Pond in ten years, Spot-Mystic would be less than the

1. Ibid.

cost from Long Pond. Projecting their calculations twenty years into the future, they concluded that the Spot-Mystic Plan to be $117,302 less for the same amount of water. On the second point of comparison, sufficiency of supply, they "believed"[1] both sources were adequate so when they arrived at certainty of supply, Treadwell and Hale lost their previous certitude about the accuracy of their estimates and Baldwin.

In their attack on Long Pond, while, Hale and Treadwell, said, the construction proposed for the aqueduct to bring in the water from Long Pond;---"shall be as much beyond the reach of interruption in its operation, as any work of human art can be beyond the reach of accident---we cannot pretend---that the cost given in our estimate, is sufficient to produce a work of this permanent and perfect character---".[2] And they didn't think any more money should be expended to make it perfect. To the counter argument that the Spot-Mystic Plan would require the use of machinery, always capable of breaking down, they pointed out that if that were to happen, the supply from Spot Pond, coming by gravity to the City would be large enough at all times to provide the full supply, during any period of occasional interruption---" even should it be to the extent of bursting all steam boilers, or burning down the engine house...."[3]

1. Ibid.
2. Ibid.
3. Ibid.

As to the quality of the water. Spot-Mystic, they said, was more pure than Long. Which was not to say that Long was not pure enough, but if it had to be brought in an aqueduct of a construction they described, a cement which would not dissolve in the water had to be used, otherwise lime or other foreign matter would make the water disagreeable to the taste, and be injurious to its softness. English Roman cement might be used, but that would increase the cost substantially. The majority of the Commissioners, all things considered, recommended the water be brought in by the Works from Spot and Mystic Ponds.

Turning then, to a plan for distribution within the City, they recommended in addition to the Reservoir on the summit of Beacon Hill, one under the summit of Fort Hill. The first would be a hundred and four feet above tide water, and the latter fifty feet above it. The water would flow into these Reservoirs during the latter part of the day and at night when usage was at its lowest, so that there would be sufficient water in the Reservoirs to supply the service pipes each morning when the usage would be greatest. Beside providing for an ample supply at all times, this plan had the added advantage of allowing the pipe from the Reservoirs in the City to the source at Walnut Tree Hill to be of much smaller dimensions and less expensive.

The Commissioners would lay iron mains in various directions, of from six to twenty inches diameter, through the principal streets of the City to a length of approximately eight and a

third miles. By the side of the mains they proposed to lay small iron service pipes, three inches in diameter, from which the water would be taken by small leaden or wrought iron pipes to the houses. By laying this double line of pipes, flow would not have to be interrupted when a new home was tied into the system, and extensive digging would be unnecessary. The service pipes, on both parts of the streets, would run eleven and one quarter miles.

In those streets which the mains did not run, the distribution would be made by single pipes of three or four inches in diameter, communicating with the principal mains and with each other. This would require twenty six miles of pipes, thus the total length of streets travelled by the works would be forty-two and one third miles, "being all the streets, and lanes, laid down upon Smith's map of Boston, after deducting therefrom five and three quarters miles for streets laid out but not built upon as yet."[1]

There was to be four hundred and forty seven fire plugs in communication with the mains and pipes. These fire plugs could receive a supply of in excess of thirty gallons from the source without the City and whatever was in the Reservoir on Beacon Hill. Since the height of the source was at least a hundred and four feet above tide water, the water could be played directly to the top of any common building situated in a low part of the

1. Ibid.

City. The cost of distribution, including an additional 5 1/2 miles to bring the water to South Boston, would be $657,554 or a total for the completed works of $1,507,560. Feeling, it seems, some compunction to further justify such a large expenditure of money, the Commissioners concluded their report with a passionate presentation of the value of such Works from the viewpoint of health, growth, commerce, increased wealth and protection from dreaded fire.

Commissioner Baldwin appended the reasons for his non-concurrence to the Commissioners' report. It was the necessity of using machinery to pump the water up from the Mystic Pond. He stated that the manpower, machinery and maintenance would require great expense; fires that must never go out, a supply of coal which might be interrupted by acts of our Government or foreign powers. He scoffed at the savings supposedly available in the Spot-Mystic scheme as opposed to the Long and the fact that the former would require an addition in ten years.

"And what, sir, are 10 or 11 years, or what are $117,000 dollars, in a work of this description? Population is increasing and will continue to increase, whether the work goes on or not--- and if we go in this piece-meal way, we shall ever be at work and never fully satisfy the wants of the citizens."[1]

Mayor Samuel A. Eliot, to whom Baldwin's remarks were submitted, wrote back to Treadwell and Hale and asked them if

1. Ibid.

they wished to rebut their fellow Commissioner. It took them eleven pages to Baldwin's four. Their argument against Baldwin's objections was a vigorous re-statement of their reasoning for choosing Spot-Mystic in the first place. Although they thought Baldwin's contention that erecting a dam across the Mystic River so that salt water would not enter the Mystic Pond at extremely high tides(Baldwin maintained it would cause silt to form in the River and damage its navigability) unworthy of a response, they gave it one, since they felt Eddy had unnecessarily raised concern among the citizens of Medford. They cited several rivers where such dams existed harmlessly.

Chapter V

In an ordinance passed by the City Council on March 20, 1837, the powers of the Water Commission were expanded to include the necessary authority, including the letting of contracts, to bring in the water, and on the 29th, the Standing Committee on the introduction of pure water felt that the:

"...time has arrived when a decision can be made by the City Council upon the great question which has so long interested the public..." But before they made the decision, they once more, perhaps for emphasis of the answer, addressed the question; Should the water be brought in at the City's expense, or by a private company? They decided that the City should do it, explaining, in a rather radical statement for those days: "...They (Councillors and Aldermen) believe that it is too important a business to be suffered to be affected by the calculations of private interest...."

The Committee on Water agreed with the majority of the Commissioners that the water should come from Spot-Mystic. They then took formal votes that it was expedient for the City to bring in the water; that it should come from Spot and Mystic Ponds;[1] that the work should begin as soon as the City received the necessary powers from the Legislature; and that those powers should be sought immediately.

1. Boston City Records - No. 4-1838.

Nothing, it seemed now, stood in the way of the Water Works. Nothing but fate, and fate intervened.

The percarious, powerful, shaky and sometimes dishonest, banking industry of America came down with a thud. Fortunes were lost in a day, factories closed without notice, great ships idled in the harbor, not loading or unloading, but only seeking its shelter. The great Crash of 1837, in some ways worse than the Great Depression of the 1930's, had come. There was little money available, and certainly none to be borrowed for such an ambitious business as the City proposed to undertake.

But by this time the project had born a life of its own and those involved with it could not leave it alone.

Eddy submitted a document to Mayor Lincoln on February of 1838, revealing himself as a bit of a culprit in the long delay of the project. Disagreeing with Laommi Baldwin's report of 1834, he whispered into the ear of then Mayor Lyman and several members of the Water Committee of the City Council, that the plan submitted by the renowned Baldwin was impractical and too expensive, and that given permission, he might submit one of his own, which, of course he did. His communication of 1838, was essentially a re-hash of his original proposal (he takes pains to point out that the plan finally adopted by the City - Spot-Mystic was originally his) but takes issue with the plan to bring the water across the Charles on a permanent bridge.

Instead he proposes a tunnel, which, he adds, could also accommodate a pipe for the gas works.

Several Petitions for and Memorials against the Introduction of the Water were submitted to the Council signed by prominent and obscure men of the City. The one which bore the signatures of William Appleton, Charles P. Curtis and Abbott Lawrence* ended with the demand "LET THE THING BE DONE."[1]

Lucius Manlius Sargent, Esq.**, sent by a series of answers to questions he had proposed of Mr. Eliphalet Williams, Esq., President, relative to the Boston (Jamaica Pond) Aqueduct Company Mr. Williams was quite down in the dumps about the whole affair. What was he to do? If the City was going to bring in water, he dare not expand the Jamaica Pond works, and if they were not, he would like to get on with it. In despair, he threw in the towel, and offered the works for sale to the City (if the right price were offered).

*Abbott Lawrence, who took a continuing and keen interest in the water question, was a wealthy merchant of the City, having made fortunes in cotton and the China trade. He was a Whig Congressman and Ambassador to Great Britain. As Commissioner representing the Commonwealth in 1842, he settled the question of the Northeastern Boundary of the State with Lord Asburton who represented Great Britain. His gift of $50,000 to Harvard in 1847 established the Lawrence Scientific School there.

1. City Document No. 9-1838.

** Lucius Manlius Sargent, was a well known author of the day and an expostulator for the water power. He also devoted his effective pen to the crusade for temporance and against the Coolie trade.

A Mr. Austin sent along some Minutes of Evidence taken and Papers laid before the Select Committee of the House of Commons and the Commissioners of the Supply of Water to the Metropolis (London), in the years 1821, 1828, and 1834, for the edification of all who would plow through them.

On March 15, 1838, Mr. Shattuck submitted to the Council a resolution to direct the not so defunct Boston Hydraulic Company to do the job. If that resolution were not to pass, then Shattuck in his next resolution, revived the Long Pond scheme by directing the City to adopt it and then proceed to get the necessary legislation. He then killed the whole thing again by requiring that the legislation be approved by two-thirds of the City's voters and, if that by any chance happened, by two-thirds of each branch of the City Council.

On December 20, 1838, the Committee of Water answered an inquiry as to the possibility of paying a bonus to any incorporation which would bring the water to the City. They thought little of the idea since the City could do it cheaper, having the ability to borrow money (if there were any) for less interest.

Almost as if to take up its time while it waited for the financial cloud to lift, the Council sent the Commissioners back to look once more into the subject. The Commissioners confirmed their previous assumptions on the quantity of water available from Spot-Mystic and lowered the estimated cost by $10,200 because of a drop in the price of iron pipe. This factor

also lowered the cost from Long Pond by $57,810. Mr. Treadwell and Mr. Hale signed the report. Mr. Baldwin dissented. The City Council wanted to know why and Mr. Baldwin sent in his reasons to them on January 22, 1839. Nothing had changed but the level of his hyperbole. He still opposed getting the water by machinery.

"The pumping of water by steam power,---the best and most ingenious mode man can devise, must be attended with a vast deal of care, trouble, perplexity and risk, not only to this generation, but to all succeeding ones, and should---be avoided in all cases."[1]

By March of 1839, the financial situation was beginning to brighten, and it was believed that element of the three needed; source, financing and legal powers, was no longer a detriment to the commencement of the project. The City petitioned the Legislature for the requisite power, which held hearings, conducted in the manner of the examination of witnesses in a court of law. The first hearing was on the 21st of March, and by the 25th, this fair but rather cumbersome procedure led the Legislative Committee to conclude that there was not sufficient time left in that year's session to complete its work on the Act.

A report to that effect was made to the Senate, which on April 4th, ordered the Committee to report a bill, and on the discussion which arose, they were directed to bring in a resolve

1. Ibid.

for the appointment by the Governor of Commissioners to examine the whole vastly examined subject. The appointments by the Governor would come upon the application of the City. The City authorities made little attempt to hide their anger, seeing the Legislation for what it was, an attempt to put the whole subject back to its beginning, as they themselves so often had. Since communications between two governments is usually couched in the most genteel language, especially in the nineteenth century, the response from the City can only be described as written in venom.

The fourteen years of controversy since Quincy first called for the water, the surveys, reports, petitions and agitations, both for and against the project, its size and source, seemed to have wearied the combatants. In September of 1839, the Committee on the Introduction of Soft Water Into the City of the City Council, issued a low keyed and well thought out review of the proposed project, lamenting that there "has been less public interest displayed in it than in other years, and it has appeared almost forgotten by others, (but) they are themselves more than ever impressed with the propriety, the expediency, and within a few years, the necessity of the measure."[1]

They blamed the Engineers, since they could not agree as to the source. The friends of the project were divided, weakening

1. Boston City Records - Document 29-1839.

their efforts. They also felt that the large quantity the Engineers called for, was difficult for the public to digest and fear of the cost of such a massive works, hurt the cause.

Continuing in a concilatory vein, they forgave the proprietors of the Jamaica Pond Aqueduct their opposition, pointing out that no one could blame them for using all honorable means to preserve the value of their franchise. The Committee then proceeded to cut back the project. Assuming that the need at present and for the foreseeable future would be 2,000,000 gallons per day and 1,700,000 was available from Spot and considering that source, for the first time, 300,000 would be available from Jamaica Pond, they would combine those two sources. This elimination of the Mystic Pond would eliminate the necessity of the second Reservoir and they would also eliminate the Reservoir on Walnut Tree Hill in Medford and reduce the size of the pipes bringing the water to the City. The cost of their proposal would be $650,000, which price included the purchase of the Jamaica Pond Works for $100,000. The cost for distribution within the City they believed to be $600,000. The interest on this money for the time before it would be paid back, at 5% would be $62,500, immediately reduced to $50,000 by the rents from those customers who were already taking the water from Jamaica Pond. Five thousand tenants at $10 per year would cover the interest and they felt that 5,000 (or 6,500 including the 1,500 now using the Jamaica Pond water) out of City with 13,500 families was an easily attainable goal.

The Committee instructed the Mayor to apply to the next session of the Legislature for the authority needed by the City to finally

bring in the water and also to negotiate for the purchase of the Jamaica Pond Aqueduct.

But petition was never made and that sober and well reasoned report by the Committee on Water became the projects lamentation.

In 1843, James Odiorne asked leave to bring water into the City from Spot Pond. He never received it.

Chapter VI

The affairs of men are not always theirs to manage. With each passing year the water supply in the City dwindled. Wells dried up, the drilling of new ones caused nearby wells to fail. Cistern water grew ever more contaminated from the growing City's pollution. Fires were a constant threat and too often a disastrous reality. And a blight was to strike at a distant island's stable crop and the trickle of immigrants from that unhappy land who had heretofore come to the birthplace of America's liberty to find their own, was soon to be a flood of men and women fleeing death.

In 1844 a new Water Commission was appointed, retaining Nathan Hale and James Baldwin but replacing Daniel Treadwell with Patrick Tracy Jackson. Jackson had amassed a large fortune in the Indian trade and used it to enter into cotton manufacturing with his brother-in-law Francis C. Lowell. In 1821 he purchased a large track of land on the Merrimack River for his manufacturing plants and thus laid the foundation for the City of Lowell. In 1835 he completed building the Boston to Lowell Railroad, but the crash of '37 wiped out most of his fortune and he became Superintendent of the Locks and Canal Company of Lowell.

While the Committee on Water had been cautious and concilatory in their last report of 1839, the new Commissioners were not and the project took a quandum leap. Based on the fact that the City's population had more than twice doubled in the last

fifty years and was now near 110,000 they proposed to get enough supply for 250,000. Again using as their measure that daily supplied to the Citizens of Philadelphia, 28 1/2 beer gallons, they projected a need of 7,125,000 gallons a day. Without Treadwell present to protest, they quickly abandoned Spot and Mystic-Spot (without even mentioning them, since, one supposes, they felt those sources could not supply the huge amount they now felt to be needed) and turned to Long Pond in Natick.

Using their own measurements and those of Mr. Knight who owned a woolen mill and cotton mill there, they determined that the supply was sufficient and, could be made even more so if the dam would be raised five feet, expanding the already 600 acres of existing surface. This would result in a Reservoir of 128,502,000 cubic feet of water, enough to sustain a continuing draft of 12 feet a second for a period of 124 days, or seven feet for 212 days. Certainly enough to supply their proposed Reservoir at Corey's Hill in Brookline with the eleven feet per second they wished, in the driest of seasons.

Turning then to the mode of bringing the water to the Reservoir, they travelled to New York to examine the newly completed Croton Aqueduct which was to supply the City of New York. In comparison to the New York Water Works, even the ambitious plans of the Commissioners were dwarfed. The Croton Aqueduct could supply water to two reservoirs one of 20,000,000 capacity and one of 150,000,000; over twice the length of the

one they were proposing and built through some very rugged terrain, necessitating much tunneling. The conduit was 7 feet, 5 1/2 inches in width and 8 feet, 5 1/2 inches at its greatest height. The Commissioners were convinced of the excellence of its construction and felt assured that the same would be, on a smaller scale, best for the Boston Works.

The Long Pond Aqueduct, to bring enough water to the Brookline Reservoir for a day's supply (7,000,000 gallons), would be of brick, laid in hydraulic cement, of oval construction, five feet in width and six feet in height. The brick work would be eight inches thick and the whole structure covered with an embankment of earth, four feet in depth. The water would fall three inches a mile, and the necessary 11 feet a second to be delivered to the Reservoir could be attained by filling the Aqueduct to a depth of three feet ten inches, leaving a space of more than two feet empty.

These dimensions were, of course, larger than the Aqueduct proposed in 1837, but the additional supply and the wish for added height so that more satisfactory distribution could be made to all sections of the City, justified the extra cost, the Commissioners reasoned.

The line of the Aqueduct would initially follow that of Baldwin's out of the Pond, but then as directly as was possible to the Reservoir on Corey's Hill. The Commissioners saw no problems arising along the route, and thought the only two

obstacles of note was the crossing of Valleys of the Charles River Lower Falls and Lime Cove, beyond Brighton Valley. They would cross these by two iron pipes, each 30 inches in diameter, the total length of pipes would be 2,437 feet.

If the water were taken from the Pond at a height of 124.86 feet, and about four feet were allowed for the inclination of the Aqueduct and 15 inches for fall at the two valleys, the surface at the Reservoir, when filled, would be 119.61 feet above marsh level.

They recommended four Reservoirs in the City; Beacon Hill, Fort Hill, Dorchester Heights; and Copp's Hill in the North part of the City. The Reservoirs could be dispensed with if pipes of a sufficient size came in from Corey's Hill, but to maintain an uninterrupted delivery of water at a high level, the Reservoirs were best.

The pipes from Brookline, two of iron 30 inches in diameter, would run to Tremont Street near the Roxbury boundary; a branch of 12 inches would run to Dorchester Heights to supply South Boston; then one of the two mains would continue through Tremont Street to Boylston Street, and branches would be carried from there to the Reservoirs on Beacon, Fort and Copp's Hill. The water would arrive on Beacon Hill at the height of 111.61 feet above marsh level; 4.68 feet above the level of the State House floor and 60 feet above the foot of the columns "in the Piazza in front of Tremont House".[1]

1. Boston City Documents - No. 24-1844.

The cost for the 7,000,000 gallons daily - $2,118,535.83, including the 10 per cent for contingencies.

The Committee on Water responded to the report by adopting three resolves. That the supply should come from Long Pond, that it is expedient that the City begin as soon as possible and that the City Petition the Legislature for necessary powers. The resolutions were joined questions which were to be put before the voters as part of the municipal elections on the second Monday of December, 1844. The voting Citizens of the City showed a more decisive attitude toward the project than had some of their leaders over the years. To the question of the water coming from Long Pond - 6,260 yeas to 2,204 nays. The questions of the City bringing the water in and the Petition of the Legislature for the power were passed with equally large margins. The two questions that the opponents had placed on the ballot - to bring the water in from Spot Pond and to have it paid for only by those who used it, were defeated.

It had been twenty years now since Treadwell first listed the means and matter necessary to procure an adequate supply of fresh, sweet water. The battle which had engaged the City and all of its Citizens in greater or lesser measure for those two decades was now marched up Beacon Street to be fought, and finally concluded many prayed, under Bulfinch's ~~Golden~~ Dome.

The first session of the Joint Special Committee of the Legislature was held on January 6, 1845. It was one of some

joviality as the many proponents and opponents smiled and shook hands and filed their appearances, briefs, petitions and remonstances. The City of Boston and those who supported its Petition; the opponents of the project per se, the Towns of Framingham, Natick and Newton, resenting the pillaging of their communities to fulfill the needs of a greedy City; the owners of the Mills on the Pond and beyond, the proprietors of the Middlesex Canal; the Boston Medical Community which had long fought for the Water, knowing it would help them in their so far generally successful effort to spare the City from the ravages of awful plague and the people of East Boston, who, if they were not to have the water, knew not why they should have to pay for it.

The implications of the project had grown over the years, in proportion to its size. Some were apparent, some would only be realized in the passing of time.

The Bankers were, as was their wont, cautious, on the one hand the enormity of the financing of the Water Works, astonished them. On the other, if proper terms could be gotten from the City, there was profit to be made.

Talk was about of the possibility of filling in the putrid marshes of the Back Bay. And the immigrants had to live somewhere. There was much unused land in South Boston. A never ending supply of water to those two sections of the City attracted the speculators. There were pockets to be lined.

Nathan Hale, Jr., recorded the proceedings, but strangely, only wrote down the answers and not the questions.

Gentlemen of breeding disagree with each other only in circumspection and nuance, the more to wound your enemy. But such methods take time and the hearings droned on as one side, then the other, rehashed the twenty year effort to get water from Pond to pipe, in excrutiating detail.

Pity the witness who came unprepared, he would have his testimony thrown back into his face. Or one with unclean hands to suggest that the digging of more wells would suffice, if it were learned that he was in the business of manufacturing pumps. Perfidy was denounced when detected (there had been, over the years, some switching of sides as one plan then the other seemed in ascendancy).

The testimony was technical, thorough and sometimes lurid, as the minute detailing of the poor wrenches living in filth and in hovel, waiting in all sorts of foul weather for the man who had the key to the padlock on the common well to appear (which, it was implied, he often did not).

By the first of March, the legislators were growing weary, and warned the combatants that time for the introduction of legislation was growing short. On March 13th, 1845, after twenty-six sessions, the Joint Committee reported out favorably a bill which would give the Water Commission of the City of Boston almost unheard of broad powers to bring water into the City. The Commission could hire whom it pleased, pay them what it thought just, commit the City's money in any amount it deemed necessary, award, with or without bids, contracts large and small,

take property, private or governmental, by eminent domain, negotiating the price to be paid, or if it could not, bringing the matter to Court.

The Act, passed by both branches of the Legislature and signed by the Governor, was a total victory for the City and its Water Commissioners. Clause 20 provided that the Act could not take effect until approved by the voters of Boston balloting within sixty days. The campaign began immediately, with the usual arguments, for and against in the City's newspapers, on broadsides, pamphlets, in meetings and rallies. Realizing that it was their last chance, the opponents united and worked diligently emphasising as their strategy not the merits of the Water Works, but the unchecked power of the Water Commissioners. The Water Party mounted their campaign with great confidence, remembering that they had won handily the last time a question pertaining to the project was placed before the voters.

They lost. The Legislative Act was defeated, 3,999 nays to 3,670 yeas. (The vote was quite close in most Wards of the City, the glaring exception being the vote of Ward 12 (East Boston) where the measure was defeated 421 to 88. The insistance that the Noodle Islanders pay for something they could not enjoy, proved fatal).

The City Council, quickly recovering from its shock, moved to keep the now seemingly defunct project alive - by calling for another survey. But this one would be different. They removed the three sitting Water Commissioners - Hale, Baldwin and Jackson

and replaced them with John B. Jarvis and Walter R. Johnson.

Jarvis' qualifications were obvious. It was he who had built the enormous New York City (Croton) Water Works. Starting out as axeman on the survey team for the Erie Canal, Jarvis eventually became Superintendent of fifty miles of that water way. In 1827, while serving as Chief Engineer of the Delaware and Hudson Canal, he was directed to do the planning for its railway. At that time there was no railway worthy of the name in America and little was known of the primitive system in England. Having no knowledge of the subject he had been assigned, he was forced to look into every aspect of a railway, exploring, accepting, rejecting. In addition to building the railway, Jarvis trained all the personnel and drew up the specifications for all the equipment, including the first locomotive to run in America, the famous "Stourbridge Lion."

While employed as Chief Engineer of a Canal in New York State which used reservoirs to supply the upper levels, Jarvis did considerable experimentation of the total rainfall required to replenish reservoirs. In 1836 he was hired as Chief Engineer of the Croton River Water Works.

Adding to Jarvis' expertise on Water Works was the other new Commissioner, Walter T. Johnson of the Philadelphia Water Works.

While Jarvis and Johnson were busy investigating a subject that it seemed humanly impossible to find out something heretofore

hidden, the Proprietors of the Spot Pond Aqueduct Corporation, who thought they had won and were now not so sure, busied themselves trying to sell $500,000 of Capital Stock. They could manage only about two thirds of it, so they petitioned the City to buy the other third, promising in turn to make the Mayor and Aldermen members ex-officio of the Board of Directors, and giving them the right to set the water rents (provided they guaranteed a 6% annual profit to the subscribers). They also promised any number of hydrants the City wanted and three ornamental fountains, but no free water for them.

The Committee of the Aldermen who heard the petition, accompanied by one hundred signatures of some of the City's most prominent men and largest property owners thought the idea delightful and suggested that the City put the proposition in the form of a ballot question and let the enlightened Citizens who had turned down the City's plan accept the Capitalists. The City Council would not be moved. They found it "inexpedient". It would be their project or it would be no ones.

The Jarvis-Johnson report was submitted to the Committee on the Introduction of Water on November 18, 1845. One hundred and twenty seven pages long with six appendices, it investigated the oft looked into Spot and Long Ponds and resurrected the Charles River into contention. But with a new element. Since the last investigation, navigation on the Charles had been extended. If the Charles water were to be used, it would have to come from further upstream and more pipes would be necessary.

The two new Commissioners turned first to the quantity available in the sources they were considering, leaving the question of quality for later examination. The ultimate quantity of water available from any source, they reasoned, reflecting Jarvis' training, was a question of annual rainfall less evaporation. Here they were aided by three years of observations by Dr. Hale who had determined that the average rainfall in Boston was 43.34 inches and the average evaporation 11.62 leaving 31.72 of water. With other considerations that they did not list, the Commissioners concluded that from one third to one half of the annual fall of rain may be collected into the reservoirs (Ponds).

Continuing to discuss, in intricate detail, the quantity of water available from each source, Spot, Long and the Charles River, and taking into consideration the effect on each supply by dry seasons, evaporation, wastage and drainage; the cost, advantage and danger of pumping; they presented the City Council with three alternatives to deliver the water to the Reservoir on Beacon Hill:

1. From Spot Pond, 1,500,000 wine gallons a day at a cost of $636,896.
2. From the Charles River 7,500,000 wine gallons per day at a cost of $1,993,536.
3. From Long Pond, 7,500,000 wine gallons a day at a cost of $1,346,599.

They further reduced the equation to the cost of bringing in 1,000,000 gallons per day. $424,598 from Spot, $329,373 from

Charles River and $354,320 from Long Pond. They then weakened the case for Spot Pond by stating that their estimate lacked the degree of certainty they felt about Long Pond because of the crossing of the Mystic and Charles Rivers, and did the same for the supply from the Charles because of the estimate of the work that could be performed by the Engines necessary to raise the water.

Although, they said, the cost of repairs on the Long Pond Aqueduct might be more than on the Works from Charles River, the cheap cost of coal brought on by severe competition then prevailing could not be expected to last, so, all in all, the Long Pond Aqueduct would ultimately be cheaper. They felt that the estimate of the cost for distribution in the City listed by the Commissioners in their 1844 report was reasonable. That figure, $740,044 was sufficient they believed, for the City's present population of 115,000 and any increase in that population (which they estimated would be 220,000 in 20 years) would see the extension of distribution at the cost of $4.50 for each new customer.

If their projections of population growth were correct, a supply of 5,250,000 gallons a day would be necessary in ten years and 6,600,000 in twenty. Thus, if one were to take into consideration adequacy of supply for the future and the cost of obtaining it, Long Pond was obviously the best source. As an added measure of caution, they pointed out that the supply from Long Pond could be increased to 7,500,000 gallons for the additional expenditure of $75,000.00. If this were done, they predicted, (quite inaccurately as the future would prove), the City would

have a Water Works sufficient for its needs for the ensuing thirty years. Unable to leave it at that, they went one step further. For an additional 2,500,000 gallons or a total of 10,000,000 it would cost only an additional $65,000 to increase the size of the iron pipes that would cross the Charles River Valley and Brighton Valley and those from Corey Hill Reservoir to the City. The proposed Aqueduct and Reservoir were already of sufficient size for that amount of water.

Thus, the project to bring a supply of water in the City of Boston had grown in twenty-five years from 1,600,000 gallons at a cost of $641,000 to 10,000,000 gallons at a cost of $2,651,643.

(Here it would be of importance to note the history of the examinations of the quality of the water from the various sources. The science of such analysis, as the Commissioners stated in their 1837 report, was infant and inexact, but such analysis went on nevertheless, from Ferron's one in 1773 to the one by B. Silliman, Jr., attached to the Jarvis-Johnson Report. The majority of these examinations were done by the acrimonious Dr. Jackson, but some of importance were done by Professor Eben Norton Horsford. Although by academic training a civil engineer, Horsford became a prominent chemist. After studying in Germany at the Giessen Laboratory under the renowned Liebig, Horsford returned to the United States to become Rumford Professor at Harvard. It was his influence which caused Abbott Lawrence to found the Lawrence Scientific School at Cambridge. He also developed marching rations much used by General Grant's troops during the Civil War.

Horsford's father had been a missionary among the Seneca Indians and Horsford published a reproduction of the Indian language in English, German, Iroquois and Algonquin. He was devoted to archeological research and was convinced that he had found the site of Leif Erickson's ancient City of Norumbega along the banks of the Charles River).

Chemical evaluation of the purity of water was, in essence, restricted to its chemical contents, taste and color. In this respect, the analysis done by Dr. Stillman for the Jarvis-Johnson report was typical. Using thirteen samples from such diverse sources as Mystic Pond, the Croton River, Spot and Long, the Schuykill in Philadelphia, and a well at No. 20 Beacon Street, Boston, Stillman tested each for their specific gravities, carbonic acid in a standard gallon, solid matter in 100,000 parts by weight, grains of solid matter in one gallon, grains volatile in redness, Anhydrous solid matter, sulphuric acid and lead desolved. He also, previous to his analysis, made notes of "Sensible Properties Observed."[1]

In observation he found one sample from Spot Pond to contain a few small white floes, inodorous, sapid. From that Section of the Pond between "the island and the southeast shore at a depth of 8 and 13 feet, he found the water had a tint of color greenish yellow with scum on standing quiet for a time, odor unpleasant and by no means agreeable.

1. Boston City Document No. 41-1845. Appendix page 10.

The water at the outlet of Long Pond, he found transparent, entirely inodorous and tasteless. At a depth of 62 feet, he found it turbid, color reddish brown, and almost marshy in taste.

His sample of the Charles River at Watertown, was transparent, but not perfectly so, inodorous, but slightly sapid, leaving a somewhat harsh or rough impress on the palate. And that from the same River in South Natick, he discovered to be brownish yellow in color, with no sensible turbidness, quite transparent and with a fresh odor. It was also insipid, leaving a pleasant taste in the mouth.

The carbonic acid in the samples ranged from 0.999842 in the Charles River at Natick, to 1.000118 in the same river at Watertown; solid matter from Spot Pond at a depth of 26 feet, to 10.719 in Long Pond at the outlet; grains of solid matter in a standard gallon from 1.850 in Long Pond to 6.190 in Spot Pond; grains volatile at redness in one gallon from 0.63 at Long Pond to 1.58 in Spot; Anhydrous solid matter per gallon from 1.22 in Long to 4.62 at Spot; the water having the lowest amount of sulphuric acid in one gallon was the water in the Charles, (0.00137), and the highest 0.011 in Spot and the final analysis showed that the amount of grains of lead dissolved were lowest in the water (0.46) in both the Long Pond and Charles River and the highest in the water of Spot. (.215)).

The response of the opposition to the Jarvis-Johnson Plan, was harsh, expected and quick in coming, as was the proponents.

Messrs. Wilkins and Shattuck, hastily wrote and privately published a pamphlet decrying the plan as needless, excessive foreboding of financial disaster and economic havoc. Nathan Hale, signing himself "a member of the late Board of Water Commissioners" responded in a point by point rebuttal of their objections and those of some who had testified before the Legislature at the time the City was petitioning for the necessary authority.

On March 30, 1846, the House and Senate passed and the Governor signed, an Act again granting to the City of Boston, the necessary rights and privileges to begin to bring to life a project which seemed a year earlier to be still born - the Water Works of the City of Boston.

This piece of legislation was, in its essentials, the same Bill which had been rejected the year before by the Citizens but contained some controls over the Commissioners. They could only serve for three years, or until the project was completed, whichever came earlier. But were eligible to be appointed for another three years if the project was still incomplete. The votors accepted the legislation.

Chapter VII

On August 20, 1846, the former President of the United States, Congressman John Quincy Adams, then approaching his eightieth year, joined Mayor Quincy and other dignitaries on a festive train to Natick to break ground for the long elusive Water Works of the City of Boston.

The City Government had moved swiftly after receiving approval for the project from the voters. They reconstituted the old Water Commission, reappointing Hale and Baldwin and replacing Jackson with Thomas B. Curtis. The Commissioners moved no less swiftly lest foe or fate interfere once more.

In their first monthly report of June 11, 1846, the Commissioners reported that they had hired a clerk and office space (having found none suitable in City buildings) at the corner of Tremont and Bromfield Streets; hired John Jarvis as Consulting Engineer for the sum of $3,000 per year; decided to hire two Chief Engineers, one to bring the Aqueduct from the Pond to the Reservoir either in Brookline or Brighton and the other to bring the Works into Boston. They had conferred with Mr. Knight about his rights to the Pond, and purchased a lot of land of John Hancock, through the agency of Mr. Thomas Smith. The lot, land bound, was 17,392 square feet and was purchased, as the site of the Beacon Hill Reservoir at two dollars, two and nine tenths cents the foot.

In September, the Joint Standing Committee on Water was able to report to the full Council that Mr. E. Sylvester Chesbrough had been hired as the Chief Engineer of the Aqueduct Division and Mr. William S. Whitwell, Esq., Chief Engineer of the City Department. The gentlemen, each under a Resident Engineer, began immediately to survey for an appropriate line. For $150,000 the Commissioners had purchased all of Mr. Knight's rights to Long Pond, his factories, mills, dwelling houses ofoperators and out buildings. Just to make sure that they had such authority (they did), they had the City Council confirm their actions. The Chief Engineer of the City Department busied himself with making plans and estimates of Cost for the Reservoir and constructing an accurate plan of the City from actual surveys. The Commissioners decided on what route the Aqueduct would take on the first five miles of its journey from the source to Needham. They had so far, they reported, expended $205,613.80.

The Jamaica Plain Aqueduct Corporation, seeing its monopoly to deliver water going, and convinced that the City would sell its water at cheaper rates, and long ignored by the Water Commissioners, decided to go down fighting. They notified fifteen hundred of their customers that they would no longer receive water from Jamaica Pond. The Company intended to just deliver water to the low sections of the City in the hope that concentration there would decrease its expenses and make it competitive with the City Works.

Josiah Bradlee and other customers who faced a shut off, petitioned the City. Since they had long been supplied from the Aqueduct, they had no wells and unless they had the money to dig them, or indeed if any productive ones could be found, their property's would have to be abandoned with great loss to the City's Revenues. Could not the City tie one of its mains coming from the Brookline Reservoir into the Pond, or better still buy the Aqueduct Corporation? The problem they faced, was, after all, the fault of the City, they concluded.

The Commissioners responded that they would be willing to buy at the right price, which they thought to be $80,000 knowing that after the introduction of their water, the rents of the Jamaica Plain Aqueduct Corporation would plummet or disappear altogether.

By the time of their second quarterly report, January 2, 1847, the Water Commissioners were able to report that most of the contracts had been let and that some of the excavation from Long Pond where the Aqueduct would sit had already begun. The Commissioners had determined that by tunnelling through two rock summits, one in the Town of Newton and one in Brookline, the line of the Aqueduct (by this time finally settled) could be shortened to a little less than 15 miles and the crossing of the Brighton Valley avoided. This change necessitated the abandonment of the long proposed Corey Hill site for the Reservoir and the substitution of a piece of land mainly owned by one John E. Thayer, Esq., on the south side of the Old Worcester

Turnpike, near the Brookline Meeting House. To expedite the tunnelling, shafts were sunk less than 400 feet apart and men worked in each section, in three eight hour shifts, twenty-four hours a day. One tunnel would be of a length of 2,300 feet, the other of 1,150.

The only pipes to be used from the source to the Reservoir in Brookline were two 30 inch iron pipes to take the water across the Charles River at Newton Upper Falls.

For the Reservoir on Beacon Hill, the Commissioners took by eminent domain a lot on Derne Street to add to that purchased from John Hancock estate. It was proposed that the Reservoir would be 200 feet by 125 feet, covering an area of 25,000 square feet and capable of holding two millions of gallons. The depth of the Reservoir would be 15 feet and the height of the water 20 feet above the level of Mt. Vernon Street, sufficient to convey the water to the second story of the highest dwelling house in the City. The contract called for the completion of the Work, ccntaining 17,000 cubic yards of hydraulic masonary and concrete by August 15, the next year.

Lest the Commissioners begin to think that they had put controversy behind and were going to be left alone to get on with it, one Silas B. Barnes (and others) soon removed that happy prospect. The gentlemen felt, and so informed the Mayor, Aldermen and Common Council that all was not as it should be with the project.

Their complaints were several in number Citizens of other States had been appointed to posts of importance at exorbitant salaries; contracts had been entered into with contractors from abroad; contracts were not being awarded, as promised, to the lowest responsible bidder; and the Commissioners were, in general, "casting an imputation of incompetency upon our Boston mechanics, to the manifest injury of their reputation."[1]

The Commissioners replied on February 8, 1847. The authority given to them by the Legislature, they pointed out, allowed them to hire whomever they pleased, using their own judgment of their competency, and to let contracts out either by sealed bids or negotiations, whichever they thought best. And since none of the gentlemen whose names appeared on the Petition, had any interest in any of the contracts, and since most of them (contracts) were yet to be executed, the inconvenience that might result by publication of the contracts, precluded them doing so.

To the main charge, that the contracts given out for the construction of the Reservoir on Beacon Hill were not given to local firms competent to do the work, the Commissioners could hardly believe it! It was a charge "unsupported by a particle of truth."[2] They pointed out that on this particular contract the petitioners indeed had an interest, since no less than five of the Petitioners had submitted proposals. All of which, they pointed out, were higher than the contract awarded. While not

1. Boston City Records No. 8-1847.
2. Ibid.

so to the petitioners, the Commissioners' response was sufficient for the Committee on the Introduction of Water of the City Council.

By July of 1847, the Commissioners could report that, with the exception of a small section, construction of the Aqueduct was going on all along the line. The only delay that they could possibly encounter, was the available supply of brick keeping up with the work.

It had been thought by the Commissioners, that by changing the original plans and tunnelling in Brookline and in Newton, thus avoiding having to cross two valleys, money would be saved both in construction cost and the length of the Aqueduct. But they were having trouble at both sites. The workmen were encountering an unexpected amount of hard rock and when it was removed the excavations soon flooded. The Engineers were forced to employ in its construction what the Commissioners had refused to in delivering the product of the Works - engines and pumps. They were constantly at work, while the miners toiled. The new route, the Committee was assured would still be cheaper.

The water of Long Pond had been drawn down preparatory to the erection of the dam there; almost eight miles of pipe for distribution in the City had been laid, nearly all the land along the margin of the Pond had been purchased; the Commission had spent $659,856.13. As Eddy's machinery had been used, so had Treadwell's money.

It must be said that the continuing increase in the cost of the creation of the Boston Water Works, was as much a function

of the forward looking nature of its planners as their propensity to spend. That the size of the Works and the amount of water they would supply would not be needed for years to come, was not a function of needless spending, but rather the result of judicial planning. In July of 1847, 1,711 Citizens of South Boston, petitioned the City to add enough land to that which it would take for the Reservoir, so that a suitable Public Park or Square could be built on Dorchester Heights. To the petition were joined the signatures of some of the City's most influential Citizens - Abbott Lawrence, Harrison Grey Otis and Stephen Fairbanks, who saw it as an opportunity to bring to fruition a proposal they had long been making - a proper park which would be a memorial to the Revolutionary War fortifications there.

The proposal was to take 400,000 feet of land extending from G Street to Old Harbor Street, east to west, and from Seventh nearly to Fifth Street, north to south, "embracing the summit of the western-most of the hills known as Dorchester Heights, with the remains of the fortification built by Washington."[1] The Reservoir would take 120,000 feet; and the additional 280,000 feet would add $112,000 to the cost of the project. There was some objection, but a joint Special Committee of the City Council felt that South Boston, although paying its share of taxes, did not get its share of benefits; the park would attract more people to live in South Boston, and the site of such historical

1. Boston City Document No. 29-1847.

significance ought to be under the jurisdiction and protection of the City.

As if the long delays and troubles the project in general had was destined to contaminate each aspect of it, the City was having trouble coming up with the permanent financing, being forced to pay for the project as it was building from its own revenues or short term borrowing.

In June of 1846, the Joint Standing Committee on Finance was authorized to borrow a sum not exceeding one and one half million dollars. They were sure that the money could be procurred in Europe at a low interest rate, no higher than 4% per annum. They were to be disappointed. The Bankers of France, England and Holland, attracted to the excellent investments in railways and railway bonds and anticipating coming pressure on the money market, refused even to make an offer. (That failure was to put a stain upon American stocks). When they turned back to the United States for the money, they ran into a significant offering by the Federal Government, which produced a premium and made it impolitic to try to get the permanent loan, ~~At~~ that time.

Those circumstances forced the Committee on Finance to continue to fund the project by short term borrowing. In April of the following year, on the 30th, they advertised for a loan of one million dollars. Each of $200,000 principal would be paid back at differing dates of maturity ranging from April 1st of that year (1857) to April 1, 1861 and bearing an interest rate

of 5%. (They issued the paper in certificates as low as $500 "such as would fit the convenience of the smallest capitalist."[1]

The City heavily advertised the offering both in the money markets of the United States and Europe. The whole amount was sold, taken at an average of about 94 for 100. The Committee noted that the effective interest rate was more favorable to the borrowers than that they had received from the recent United States issue, but less than many had anticipated, and insisted that it got the money at the best rate, under the circumstances. They felt that they could not have taken any steps toward a permanent loan until a change had taken place in the financial condition of the country.

The progress of the Works was aided substantially by the mild winter of 1847, so much so that the Water Committee in their semi-annual report of December, predicted that the completion target of late 1848 would be reached.

Turning their attention then to Reservoirs in the City, the Commissioners pointed out that the start of construction on the Beacon Hill Reservoir had been delayed by the time consumed in obtaining possession of the buildings which occupied the site. The Mayor had not been able to set the corner stone until November 22nd, 1847.

It had been decided to increase the size of the Reservoir to 40,000 square feet. The Reservoir's foundation extended from Hancock Street on the West to Temple Street on the East, and from Derne Street on the North to the rear of dwelling houses on Mt. Vernon Street on the South. In order to give a regular

form to it, Derne and Hancock Streets were straightened and widened. The Commissioners were able to obtain all the land necessary by purchase (one sale being made to them after legal proceedings to take it had begun). The land consisted of a lot of John Hancock, unoccupied by buildings, a house owned by the Commonwealth which was the residence of the Sergeant at Arms; the Bowdoin School House owned by the City, several tenements owned by Benjamin Adams and four dwelling houses.

Much of the land had formerly been the estate of the late Governor Hancock, and included the most elevated part of the City. This hill received its name from a Beacon which was erected in the early years of the Town on its summit to welcome ships coming into the harbor. The Beacon was blown down in 1789 and replaced by a Doric Column, 60 feet in height, commemorating events of the Revolution. When the summit of the hill was dug away and used for the making of lands reclaimed from the sea, the Doric Column was in danger of being undermined and was taken away. Had the Commissioners observed, only half of the summit of the hill had been left, their work would be less. As it was, they had to replace the dug land with a foundation of massive masonry.

The site for the Reservoir on Telegraph Hill in South Boston had been selected, but no plans had been drawn up for it. The Commissioners had determined, however, to bring the water to the peninsular by a branch from the 36 inch pipe coming from the

Brookline Reservoir to the corner of Tremont and Dover Streets. The branch, a twenty inch pipe, would pass directly by the route of the South Bridge to South Boston, either under it or beside it. It would be covered by earth to protect the pipe from erosion caused by the salt water and would be laid so low as not to interfere with the flow of the tide or the passage of vessels.

The Commission had purchased the land for the Reservoir at Brookline from John E. Thayer, Joshua C. Clark, Charles Heath and the heirs of David Hyslop. The land, including the surrounding embankment, amounted to about 38 acres. The area of the water surface would be about 22 1/2. The work had already begun with the shaping of the embankment. The earth not impervious to water had been removed, and replaced by puddled earth. It was the plan of the Commissioners to so construct the Reservoir at Brookline, that water could be discharged into the pipes to the City either directly from the Aqueduct or from the Reservoir. In this way, the water could be brought into the City even before the Reservoir was completed, if need be. The same applied to the Reservoir on Beacon Hill.

The tunnels in Brookline and Newton were still a problem, much more rock being encountered than anticipated and the water problem forced them to engage seven steam engines to pump it out. Nevertheless, 2,310 feet of the 3,593 had been excavated.

Water seemed to be the enemy of the Water Works. Three pumps of a large size had to be used for removal of water in

sections 1 and 2 of the excavation for the Conduit. Quick sand was found in certain places. However, nearly half of the masonary of the conduit, a little more than seven miles, had already been completed.

Four large culverts and several smaller ones had to be built to convey the water of brooks or ravens which crossed the line of the Aqueduct and were built of substantial masonry laid in hydraulic cement.

The dam at the outlet of the Pond, was nearly finished, they reported. The foundations of the piers and abutments for the arched bridge that would take the conduit across the Charles River at the Upper Falls in Newton were raised above the water, and a large embankment of puddled earth had been constructed across the valley near the Charles in Needham, forty feet in height, to receive the brick masonry of the Conduit. The lands bordering the Pond had been secured against use by man or animal which might contaminate it.

Although most of the land over which the line of the Aqueduct was to pass had been purchased, the Commissioners were having difficulty negotiating the purchase of others. They attributed this to the fact that much of the line ran quite close to the Boston and Worcester Railroad, and the owners of such parcels had an extravagent idea as to its worth. "The progress of negotiations (despite their desire to do ample justice to the

proprietors) has often been tedious and dilatory."[1] All lands purchased have been paid for, they continued, as well as all work done. Total expenditures as of December 2, 1847 - $1,442,951.85.

1. Boston City Document No. 44-1847.

Chapter VIII

It has been said that at the time of the War of the Revolution, there were, proportionately, more educated men in Boston than in any other city in the World. The Puritan belief that if a man were to ably serve "Churche and Commonweale" and to avoid the importunities of the Devil, he should be educated, led the Great and General Court of the Massachusetts Bay Colony to degree, in 1642, that parents were responsible to see that their children could read and write. Before that body made it obligatory, in 1647, that every Town with 100 families must have a "Latin Grammar School" Boston already had its, as did Roxbury.

It was tradition that the graduates crossed the Charles to Harvard and in the early part of the Nineteenth Century, when some fortunes were settled, the tradition was expanded if one's field were medicine, to travel from Cambridge to the great Universities and hospitals of London and Berlin. When one returned, he was truly fit to serve his fellow men.

The five members of the Board of Consulting Physicians to the City of Boston to whom the Water Commissioners turned to determine the best material for the service pipes in 1848 were distinguished men of that tradition. Dr. John C. Warren, Dr. George C. Shattuck, Jr., Dr. Jacob Bigelow, Dr. George Hayward and Dr. John Ware.

Dr. John Collins Warren was the son of Dr. John Warren, who participated in the Boston Tea Party and at age twenty-two was appointed by General Washington as Surgeon at the Army General Hospital on Long Island. After the war, he became a prominent surgeon in the City and was one of the founders of Harvard Medical School. His brother, Gen. (Dr.) Joseph Warren fell at Bunker Hill.

John Collins Warren had followed his father as Professor of Surgery and Anatomy at Harvard and became one of the best known and respected surgeons in America. When he was in his seventieth year he lent his considerable skill and unequalled reputation to W. T. G. Morton's first application of ether during surgery on a human.

Dr. George Cheyne Shattuck was graduated at Dartmouth College in 1803, and from the medical school there in 1806, receiving the degree M.D. in 1812. He was President of the American Statistical Association from 1846 to 1852, and received his L.L.D. from his alma mater in 1853. He founded the Shattuck School at A Fairbault, Minnesota and gave liberally of his fortune to it, building the observatory there.

Dr. Jacob Bigelow, like many of his peers, was a man of many interests - physician, inventor, botanist, writer. He was a moving force in the establishment of the rural cemetery at Watertown, Massachusetts - Mount Auburn - and a founder of the Massachusetts Horticultural Society. Bigelow was, for fifty years,

Professor of Materia Medica at Harvard and from 1816 to 1827, Rumford Professor there. At the time he and the others would be called upon to determine what material would be best to transport the water from mains to the houses, he was President of the American Academy of Arts and Science, of which he was a member for sixty-seven years.

These distinguished men concluded that from the viewpoint of economy and flexibility, lead was the best material to use. But they had a problem with its effect on health. On the one hand, they had evidence of sickness ranging from light complaints, to a statement that "lead, received into the body, in certain quantities and for a certain period of time, is liable to produce alarming complaints among which are---a species of paralysis."[1] On the other hand, they had testimony from witnesses who were known to have drunk water delivered by lead pipes for many years without evident harm.

They were convinced that some lead is quickly dissolved upon the first application of the water through the pipes, but that the amount of lead traceable on that material in the water soon becomes miniscule, leading them to conclude that the interaction of certain quality water and lead forms a coating on the inner walls of the pipes.

In their decision that lead pipes are, with some exception, not injurious to the health of those who use the water through

1. Boston City Documents No. 18-1848.

which it runs, the Board of Consulting Physicians solicited the opinions of Drs. Hosack and Griscom who were associated with the Croton Water Works. Both doctors advered that, in their opinion, water from lead pipes would do no harm.

There was however, no unanimity among the Doctors whose opinion they solicited. Dr. J. W. Webster considered the lead produced in the water, used over a period of time, to be dangerous. Dr. Hayes believed that copper pipes, covered with pure tin would be the best.

As in the Act passed in 1845, there was no provision in the one passed in 1846 to include a supply of water to East Boston. In May of 1848, the Commissioners replied to a petition from the Citizens of that section of the City praying for the water. They felt that water, as well as a gas main, could be brought from the Peninsula, under the bottom of the harbor to East Boston. It would be an arched gallery, six feet in internal diameter, or eight feet overall considering the brick masonry which would encompass it. At the location suggested by the petitioners, the crossing would be three thousand feet, and the depth of the water in the middle of the channel was thirty-five feet at ordinary high tide and forty-six at high spring tide. To the Commissioners those dimensions posed an unmanagable obstacle.

Citing, as they had many times before in determining the amount of water needed, the experience of London in attempting to bore a tunnel under the Thames so that a passage way could

be obtained for Londoners to pass from one side of that river to the other, they concluded that the proposed East Boston tunnel would be too risky and too expensive. The cost of the Thames Tunnel, a project much less in dimension than the sought after one to East Boston, had risen from the estimated $860,000 to $2,660,000, took over nine years, and was finally abandoned. The petitioners believed that if the tunnel were to be dug at a depth of 80 feet, the hard clay which forms, in certain sections, the subterranian plate on which Boston lies, would provide suitable material to insure the safety of construction. The Commissioners disagreed, believing that only porous earth would be found and that, as was the London project, the construction would be plagued with continuing and perhaps fatal flooding. As to the petitioners statement that a party in New York had offered to enter into a contract to lay down an iron pipe of twelve inches in diameter, across the bed of the channel for the sum of $100,000, they must reject that in the absence of definite plans and in the belief that such a pipe would be impractical to lay in any manner which could be relied on for durability.

"The undersigned conceive that it would be irrelevant for them to suggest any other mode of supplying water to the inhabitants of East Boston, as the authority with which they are invested by their appointment, extends only to the introduction and distribution of the water of (Long Pond)."[1]

1. Boston City Documents No. 22-1848.

As the Citizens of East Boston had turned down the plans of the Commissioners by their vote in 1845, the Commissioners turned down their plea in 1848.

While the Consulting Physicians were investigating the best material for bringing the water from the mains, the Commissioners felt constrained to proceed on their own and, in fear that lead pipes would lose out in the considerations of the Doctors and Chemist, they procured iron pipes of one and one half inches which they laid down for carrying the water from the street mains to the sidewalks, and in part to the dwelling houses, so far as that branch of the work has been yet accomplished. It would be up to the house holder to bring it further.

The instructions given by the City to its Board of Consulting Physicians was to determine the best material for the pipes to carry the water the final few feet to its consumers from the viewpoint of health, safety, repairability, strength, flexibility and economy. As often happens, the theoretical men of science disappointed the practical engineers. The Consulting Physicians report did not conclude that any one material was the best, but merely, albeit in great detail, pointed out the good and bad of each kind considered.

The Commissioners, rather annoyed, pointed this out in forwarding the Physicians' report to the Water Committee of the City Council. But decisiveness was not the strong suit of the Commissioners either. They decreed that lead pipes should be used, unless of course, one wanted cast iron.

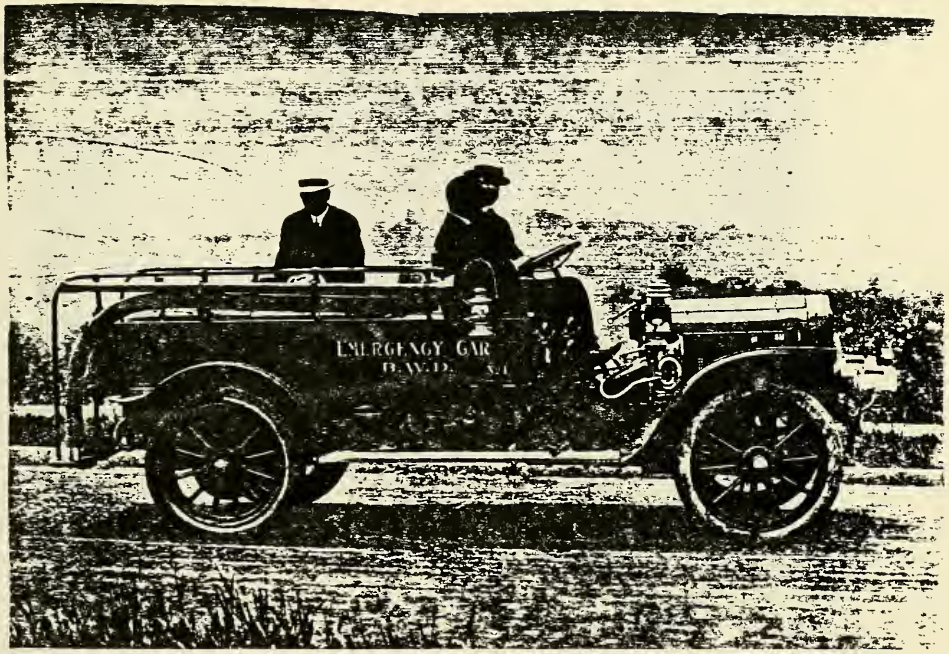
To justify their decision, they quoted extensively from an exhaustive study of the subject by Dr. Horsford, a report which concluded positively that "Long Pond Water may be served from leaden pipes with iron mains, without detrement to health."[1] The leaden pipes would be five eights of an inch in diameter, weighing three pounds to a foot in length, and conducted through such part of the cellar or foundation as to afford the best protection against frost. The pipes after having entered the house would run to the sink-room or to the kitchen, where the most constant supply would be assured. Since the water will rise and be available at any time, to any part of the house by perpendicular pipe, no tank or pump would be necessary, they pointed out. The pipe should be placed near the chimney, or in such position that it would be protected from freezing. If this could not be done, the pipe should be laid in an inclination so that it might be emptied by opening a discharge cock when danger of freezing was present.

The Commissioners, with apparent pride, stated that with the above precautions and a skillful plumber to adjust the fixtures, water could be conveyed to any part of the house at the pleasure of the occupant. If one wanted to avoid the expense of such fixtures, they could receive the water from a single stop-cock at the place where the water is introduced into the premises, or preferably, at the sink-room or kitchen.

1. Boston City Documents No. 32-1848.

There should be in all homes, a sink with a pipe to carry off the waste water. To every stop-cock, there should be attached a piece of vacant pipe, or other air chamber, which, in the event of compression of air on a sudden shutting off of the water, may serve to relieve the pipe from the shock of water hammer. If this isn't done, the pressure from so high a head of water will, the Commissioners cautioned, be liable to burst the pipes, or gradually expand them by repeated shocks.

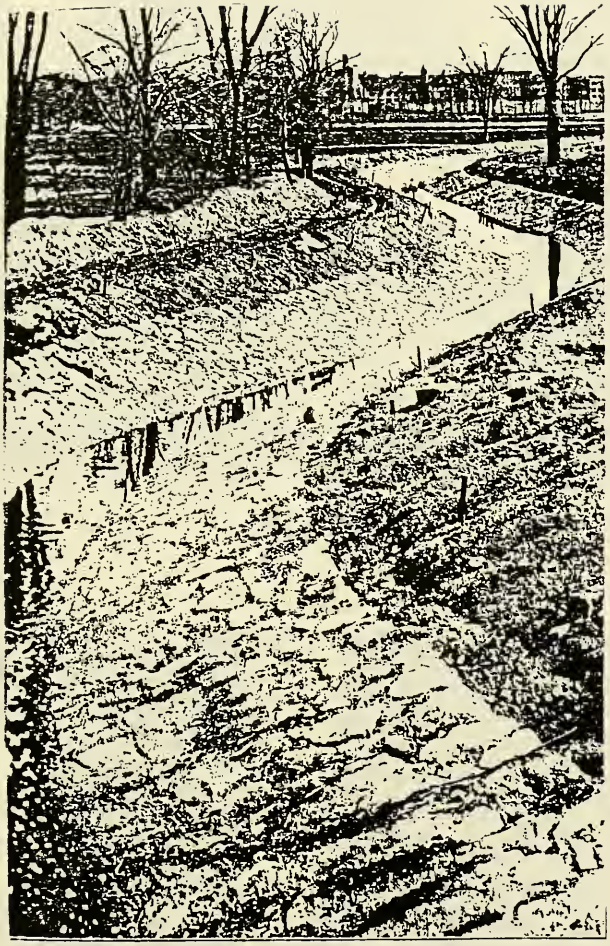
(The Commissioners then made a significant decision. It had, up to that time, been the custom for the water taker to pay for the pipes which carried the water over his property to his home. But the cost of the project was such that it was vital to the interest of the Commissioners, and the City's ability to pay the interest on its loans and eventually to retire the debt, that the water be taken by as many people as possible, the entire City if that could be managed. To induce people to take the water, the Commission voted to lay the pipes into the household at the City's expense, thus assuring an almost universal subscription to the water).



AUTOMOBILE PURCHASED JUNE 1, 1909, AND EQUIPPED FOR EMERGENCY SERVICE (See Page 84)

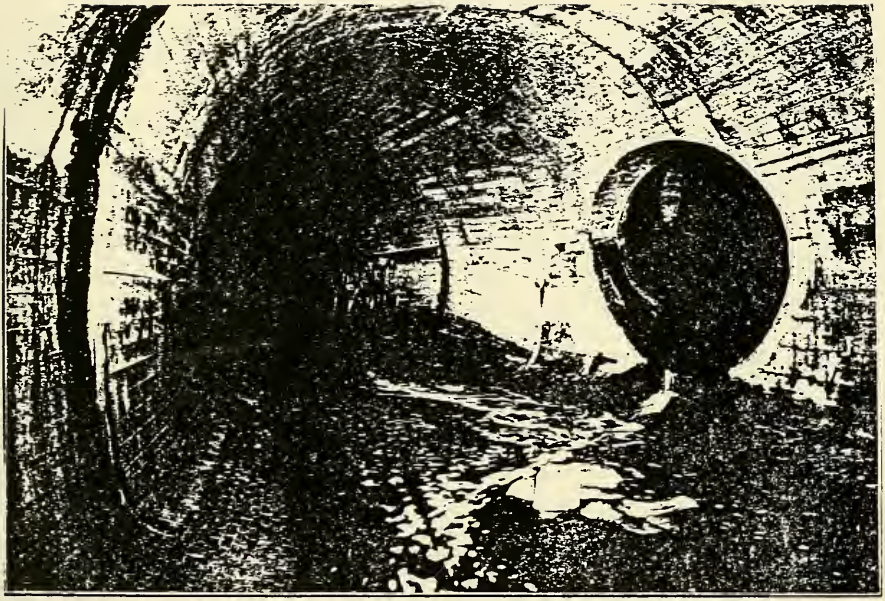
1910

LEAD PIPE GNAWED BY RATS CAUSING LEAK OF ABOUT 3,100 GALLONS AN HOUR DISCOVERED BY BEACON METER



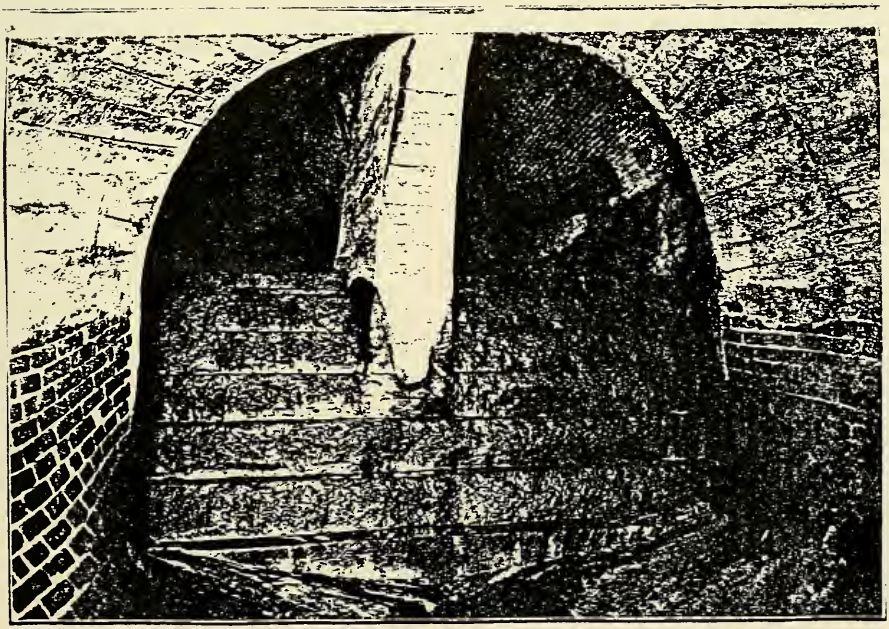
IMPROVEMENT OF CANTERBURY BRANCH OF STONY BROOK.

1912



JUNCTION MAIN CHANNEL STONY BROOK AND BUSSEY BROOK BRANCH CONDUIT AT REDUCER ON MAIN CHANNEL AT FOREST HILLS SQUARE.

1913



DETAIL OF BUSSEY BROOK CONNECTION, WITH MAIN STONY BROOK CHANNEL, SHOWING WATER-BREAK.

1913

THE WATER AND SEWER WORKS OF THE CITY OF BOSTON 1630 - 1978

by NEIL J. SAVAGE

'Tis a little thing
To give a cup of water; yet its draught
Of cool refreshment, drained by fevered lips;
May give a shock of pleasure to the frame
More exquisite than when nectarean juice
Renews the life of joy in happiest hours.

ION. ACT 1, SCENE 2
Sir Thomas Noon Talfourd (1794 - 1854)

As one who long in populous city pent,
Where houses thick and sewer annoy the air.

Paradise Lost. Book VIII, Line 445
John Milton (1608 - 1674)

Chapter IX

What the City wanted by the fall of 1848, was its water from Lake Cochituate, (at the insistance of Mayor Quincy, Jr., Long Pond and the waters which feed it were now called by their Indian name - Cochituate. Thus Quincy, with his fine sense of history linked the Sweet Spring of Shawmut, where the City had begun, to the splendid supply from Cochituate, which would sustain its life, two hundred and eighteen years later), but what it was getting was sharp October rain, chill and penetrating. On the evening of the 24th, the Whig Party had to call off its planned torch light parade. The rain showed no signs of letting up as early morning of the 25th approached. Perhaps, thought Quincy, he should call it off, postpone the entrance of the water into the City. But his patience could hardly tolerate another delay after almost a quarter of a century of them.

Then fate finally turned friend and presented the City at the dawn of October 25, 1848 - perhaps in tribute to its Celebration - with the New England weather that comes closest to the divine, a pretty autumn day, not an Indian summer reprise, not a preview of winter, but a gentle warmth and coolness, brightly hatted in a cloudless sky.

The din of the pre-arranged sign that all was well began with the rise of the Sun. First the massed cannons on the

Common, 100 lined in perfect symmetry, boomed the message in close timed sequence. Then the church bells, from every church in the City and beyond, rang out in a deep metallic harmony for all to come to the Common.

They did. The crowded trolleys could hardly move through the mass, most of them on foot since it would be a skittish day for horses. There was to be no commerce that day, nor business, nor banking, nor manufacturing in the City or the towns around it. People streamed over the bridges from Charlestown and Cambridge, walked up Washington Street from Roxbury, took the train from Dedham. The City's population would not reach that number for some years to come, but more than 300,000 came to see in fact a promise so long ago made.

They were greeted with gay decorations, banners and flags, and with lettered signs, some crude, some fancily printed:

At the corner of Park and Tremont - "PRAISE AND ADORATION BE GIVEN UNTO HIM WHO VISITETH THE EARTH AND WATEREST IT." At Beacon and Charles - "SWEET WATER SHALL RUN IN UPON US, AND BITTER WATERS BE DRIVEN OUT." And across the Frog Pond with its bright new gravel, the better to receive the water - "THE LORD SPAKE, GATHER THE PEOPLE TOGETHER AND I WILL GIVE THEM WATER." Numb. xxi.16 and in triumphant exclamation, from Gen xxvi. 32 "WE HAVE FOUND WATER!"

The Grand Procession formed along the streets by the market built by the Mayor who had years ago cried out for today's arrival.

Marching would be all the Governors of New England, all their Councils, Legislators, the Mayors of their Cities, and their educators and clergymen of prominence. Scores of units of Militia of every description and history, one uniform more colorful than the next, high ranking officers of the Army and Navy, aging veterans of the War for Independence, the Federal and State Judiciaries, the Congressmen and Senators. And a member of Her Majesty's Parliament from South Lincolnshire, England.

(Whoever's task it was to determine the order of march in each of the eight divisions, either out of frustration as to the proper protocol or an impish sense of humor, came up with some dazzling sequences. The Superintendents of the Lunatic Hospital marched three places before the members of the Massachusetts Legislature who were immediately followed by the Warden of the State Prison. All propriety was not lost to the gentleman, though. The President of Harvard, quite naturally one is to suppose, came before all the visiting Governors of the New England States.)

No one was left out, all invited. Even if, in the natural order of the day the Masonic Organizations of the State came before them, in Division Three, no less than ten Catholic Societies followed in Division Four. In the last Division, their enthusiasm undiminished by the inevitable long wait those who are chosen to be the tag end of a great parade must endure, came the School Children of Boston and surrounding communities,

led by the pupils of the Public, Latin, High and Grammer Schools, and followed by the Children from the Orphan Asylums and a good Sister of Charity leading "children over eight years of age".

The marchers were finally in their assigned places on the Common by one o'clock. Stands had been provided by the Frog Pond for those whose station in life was such as they deserved the honor, a plank over it set out for the Water Commissioners (Hale, Baldwin and Thomas Curtis. Poor Treadwell's name never passed one lip that day) and His Honor, Mayor Quincy, Jr.

A song to be sung by all, had been composed by a fellow from the Franklin Topographical Society. He had titled it "For the Merry Making on Water Day".

"Away, away with care today! There's naught but joy before us; A gladsome shout from the mass goes out, And we join the chorus. Hail, hopeful stream! from thy bright gleam Our Hearts reflect the Omen, the water's want no more will haunt The thirsty man or women."

George Russell, a man who combined academic talent with business acumen, had also written a hymn for the occasion to be sung by the Handel and Hayden Society. Mr. Russell had recently returned from Honolulu where he had built up the very large and successful commercial house of Russell and Sturgis.

"Let old and young, rich and poor, Join in one full harmonious song! And swell the Anthem loud and long!", it concluded.

The opening prayer, given by the Reverend Daniel Sharp, D.D., was unusually brief for Divines of that day given the opportunity of such a great occasion. Mr. Sharp was followed by a large group of specially chosen Boston school children who recited, more or less in unison, an Ode composed just for the event by James Russell Lowell.

"My name is Water! I have sped - Through strange dark ways Untried before, By pure desire of friendship led, Cochituate's He sends four royal gifts to me, Long life, health, peace, purity."

Nathan Hale spoke for the Commissioners. One supposes that he didn't mean to be truly literal when, while thanking everyone else concerned with the work, he added: "The City Treasury in aid of this work, has poured out its resources like water." (Mayor Quincy in his address later was to assure all that, even when the Beacon Hill Reservoir was completed in perhaps less than two years, the total cost of the project "probably would be not near to $4,000,000."[1] Some wealthy citizens were seen to blanch.)

The time had finally come. "Do you want the water," Quincy shouted at the crowd. "YES," they roared back. He approached the lanyard to the gate blocking the sluice. As if to rid himself and the City of the long years of frustration, he gave it a mighty yank. A trickle of coppor colored, dirty water came

1. Boston City Document No. 50-1848.

weakly out. Then, before any disappointment could grow, a mighty gusher shot seventy feet into the air. The momentarily hushed throng gave out a mighty yell, hats flew, young boys rushed into the filling Pond, muskets were fired, the fire company's raised their banners in salute. Some women were seen to weep - and men too.

THREE CHEERS, THREE CHEERS! Cried the Mayor. HURRAY, HIP, HIP, HURRAY! The crowd yelled back. Then, from behind those facing the Pond from the Beacon Hill side of the Common came the whomp, whomp of scores of rockets filling the air. First a representation of Neptune, his fork in hand flashed across the sky, then a great waterfall with the names of the three Commissioners and the Mayor written across it. The spectacular display continued for some minutes and then, just as an exploding American flag was fading out and sinking, in sparkling bits and pieces to the ground, there came a shout from the crowd along Tremont Street. The buildings there seemed to explode as had the fireworks into sheets of light. In each window of the Tremont House there were three gas torches, and on the face of the Gas and Light Building, light after light, which seemed to become the building itself, burst out in a massive and intricate design.

Chapter X

In 1645, one John Dotten asked permission of the Selectmen of the Town of Boston to enter his house drain into the "Common Shoar[1]". These Common Sewers, built by either a group of Estate owners or by the Town, took waste water from the homes and drained it into the canals, rivers, brooks and sea which cut through and surrounded the Town. They grew as did the Town, with no plan or pattern, at improper angles and in imperfect fit. And often in too low a grade for proper drainage. But the polluting effect on the water they discharged into was hardly noticable, if it existed at all. No human waste ran through the drains in those days before Hopper invented his flush toilet.

Yet, there were sources of filth in the City which escaped into the Common Sewers. On the first Monday in November, 1832, a Suffolk County Grand Jury indicted the City of Boston. The charge was the City's failure to abate a nuisance at the scavenger's depot on Merrimack Street. The aptly named and officially recognized scavengers were waste collectors, taking away the carcasses of dead animals, offal and rotting vegetable matter. They would cart the offensive material to the depot where they would heat it and drain off the liquid content before they proceeded to take what remained out and bury it. As the Town grew, so did the Depot, emitting a noxious odor which forced the closing of windows in the neighborhood even in the warmest of weather. But their worst offence was the draining of the putrid liquid into the Common Sewer. It was supposed to

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[1]Boston Town Records - 1645

be carried down a canal to the Bay, but filling of the canal had stopped its flow, and when it rained, either the liquid itself or its odor would flow back up and into the houses of the area.

Hearing the testimony ascribed to be twenty-five of the City's most prominent physicians that "the affuvia arising from such sources are prejudicial to health, often prove to be the fomes of fevers and a medium favorable to the propagation of contagious diseases of every description", the Court found the City guilty and ordered it to have the Depot removed.[1]

The City had begun to pay better attention to its sewers before that. In 1822 it had ordered a study by the Surveyor of Highways on the State of Common Sewers which led from the public streets and which may have made an encroachment of the Town slips. It also placed the opening and repairing of Common Sewers under the jurisdiction of the Surveyor of Highways, with authority to issue permits for such work.

The Board of Health whcih had been established when the Town accepted its new Charter as a City on March 4, 1822, was, by the following year, becoming concerned with the condition of many of the drains and sewers and the inability of some of them to properly discharge all the waste water entering them, and the state of their repair. Some permits required that the Common

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[1]Interesting Trial, Proceedings of the American Statistical Association, March 31, 1899.

Sewer could not be used unless the waste was first run through a cesspool. In July of 1823, the City Council's Committee on Drains appointed one Reuben Hastings as Superintendent of Drains. Among his duties was to make sure that drains were completed in conformity with the City direction and to the Superintendent's satisfaction and that the owner of the Estate constructing the drain used only workmen licensed by the City to assure their competance in such construction.

From the very beginning of its formalization of supervision over drains and sewers, the City had much difficulty collecting the assessments it had levied on the property of those who had joined their drains to a common sewer that the Town had built. In 1824, the Joint Committee to appoint someone to keep and collect accounts due from sewer assessments, decided to split the responsibility between the City Auditor (who would compute the assessment) and the City Marshall (who would collect it - or try to).

Later, in order to better control the construction of common sewers and connecting drains, the Joint Committee on Drains, Mayor Joshua Quincy, Chairman, reported out an ordinance which gave to the City Marshall the general superintendancy of Common Sewers. Whenever the City was to build one, the City Marsahll was to observe how it was being built, and record its depth, breadth, mode of construction and general direction in the book of plans of Common Sewers. After determining the

the valuation of any adjoining estates that might enter into the Common Sewer from the Assessor's Book he was to report the proper assessment to the Auditor of Accounts who was to report forthwith to the Mayor and Aldermen.

But the collection of these assessments remained difficult. For one thing, many believed that the City should bear the whole cost since it was its duty to look after the general good health of its citizens. The lien that was placed on the property assessed ran out after one year and if one could duck the City Marsahll for that length of time, he had not to pay. Debts far exceeded collections and by 1882, a Joint Committee was formed to look into the matter and was pleased to report that the party they had hired to adjust and collect the past due accounts had made much progress. His good fortune did not last for long. In 1840, Robert G. Shaw and others sued the City claiming it had no authority to make an assessment against them for the priviledge of entering a common sewer. After three trials, the Massachusetts Supreme Court ruled that the City had authority to make such a charge, but not against the Estate the drain ran from but only the land it ran under, thus lowering the assessment. The Court also ruled that when the City built a main sewer across vacant land, the amount of the assessment to be charged when the land was built upon and a drain constructed, should be set when the main sewer was constructed and not when the building on the lot was completed.

It is ironic but true that the arrival of the Cochituate Water, in combination with the availability of the flush toilet, not only can be counted as the beginning of the system of sewers the City now has, but also of the massive pollution of the once blue-green rivers and bay. Now to the waste water was added human excretion (night soil as it was called in polite circles)[1]. Also the availability of the water made possible development of areas of the City which heretofor were unliveable because of their lack, creating the need for more sewers.

By the time that the last half of the nineteenth century began, the Superintendent of Sewers was a firmly established department of the City's structure. The first large work of the Superintendent was a system of drainage, executed at great expense, for the southwest part of the City bordering on the Back Bay. Because of the building of the Mill Dam, a portion of the territory had not been graded to a proper height to admit of a natural drainage to the sea and to abate this nuisance it had been necessary to direct the sewage into the tide water. The Main Sewer was laid in Dover Street and Tremont from Castle Street to near the Roxbury line, which intercepted all the drains which then had termination in the Back Bay. To protect the low land and cellars from inundation, it was necessary to build the sewer with self acting tide gates. These gates were worked to stem the tide twice each day. The rest of the time the sewer was used as a cesspool or reservoir where the drainage was retained until the falling of the tide.

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[1]More accurately, human excretion used for fertilizing.

The increased use of the rapidly expanding sewer system, however, poised a problem. The drainage from the high [illegible] of the City was being run through the mains in the lower section, thus it was ending up in the Dover Street Main which was not large enough to hold it when the tide gate was shut. As a consequence, the sewer frequently filled up and flooded basements and cellars. To alleviate the problem, several weirs were built to cause the water to drain into the empty basin (Back Bay) during high tide.

The solution, unfortunately for the Superintendent at least, proved to be only temporary. As the Back Bay was being filled in to re-claim land for the City's expansion, the weirs had to be continually extended and eventually all were closed save one. The City Engineer's solution was to recommend the immediate construction of a large main sewer to commence at the Channel in the South Bay, and to extend to Dedham Street to connect to the main sewer now laid in Tremont, thereby diverting all the drainage south of Dedham Street from passing through to Dover Street Main. The proposed sewer would be about 2,600 feet long in the last section across South Bay lands about 1,000 feet to be built of lumber six feet square and placed on stilts to support it. That section would be available for the drainage of South Bay lands were they to be built on. A second section from Tremont Street to Harrison Avenue, being in original land, could be built of brick laid in cement of a circular shape six feet in diameter or an internal area of about twenty-eight feet. The

third and last section would include the building of a gate chamber with its tidal gates, and the required alteration of the sewer at Harrison Avenue at its junction with Tremont Street. The Superintendent further suggested that the continuing complaints of nuisances in vacant lots and abandoned buildings would not be cured until the City required owners to build their houses at sufficient height to allow for proper drainage.

In January of 1860, the Board of Alderman passed an ordinance requiring an annual report from the Superintendent of Sewers, the first to be submitted no later than April 30, 1860 for the year 1859. The Superintendent reported that his appropriation for that year was $35,000 and that he had expended from May 1 to December 31, $39,398.18 and had income of $15,279.62 of which $4,408.62 was from sewer assessments.

There had been built 24 new sewers in Boston proper and fourteen in South Boston. Three land depots had been built in the developing South End of the City. The amount of pipe in the City proper was 8,275.5 feet and 8,856.5 in South Boston with 1,087 feet laid in East Boston and 2,130 for the Public Land Department.

Of the total number of feet laid, 3,214 was to replace old pipes. The dimensions of the pipes ran from 12 inches wide by 16 inches high, to four feet by five feet; shapes from rectangular to square and material from timber to brick masonery. The major construction was a new sewer in Prince and Causeway Streets, and the diverting of a great part of the sewage of the District between Charter, Hanover, Charlestown and Medford

Streets, to discharge under the Charlestown Bridge.

The Superintendent pointed out the constant problems he was having with the continuing filling of the Back Bay by the Boston Water Power Company (despite its name, a real estate development company). Since the Company was now ready to fill in the Bay between the Boston and Providence Railroad and the Worcester Railroad (between the lower ends of Fayette and Providence Street) and several sewers which drained into that part of the Bay took the drainage from a section bounded by Church, Tremont, Providence Streets and the water, a new route would have to be found. The choices were two, he reported. The sewers could be extended through the filled in land, or the drainage could be diverted into the Church Street Sewer.

The streets in question were on such a low grade that they could not be drained into the Church Street sewer unless the grade was raised, a proposition the Superintendent and his successors were to advance for many years in other sections of the City. If he were to extend the sewers, he would wish to build suitable steam pumps and a building to pump out the water which would accumulate while the water was trapped by the closed tidal gates at high tide, and discharge the drainage directly into the Charles River. Or else put a covered basin near the outlets of sufficient capacity to receive the surplus drainage from the sewers during high water and retain it to the fall of the tide.

The Superintendent posed this question regarding the building of sewers by the Water & Power Company in their reclaimed but still vacant land. "If the sewer being built on private streets which now drain into the Bay, who is to assume the expense of placing buildings and land in proper condition from drainage?"[1]

Superintendent Simeon B. Smith then turned to a problem he knew to be growing and over which he felt much apprehension. "Within a few years, since the introduction of the Cochituate Water, there has been a considerable change in the substances introduced into the sewers from the universal use of water cabinets, and the carelessness of the inhabitants in neglecting to keep their drains and cesspools in order, and permitting filth and subject of improper nature to enter them. The manner of disposing of the night soil through the sewers and discharging the same upon the border of the City and its affect on the health and character of the residents and the formation of deposit in the Harbor, Docks and Sewers, have been slightly considered in other reports, but no practical result has followed, nor has the question received that attention from the Community which it demands.[2] "

As in the plea for water, nothing would be done for years about the problem until the Harber and River were almost irreversibly polluted.

Smith suggested an idea to solve the problem that was then being entertained in Europe. To separate the night soil from ordinary house drainage, retaining the solid mass upon the premises

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[1]Boston City Document No. 11-1860

[2]Ibid.

of the occupant in suitable tanks, causing it to be deodorized, removed periodically, and finally sold for agriculture purposes. He wanted a State Commission set up to investigate the problems and potential solutions of this method of disposing with human waste.

In subsequent reports, the Superintendent observed that the triparize (triparte) agreement among the City, the Commonwealth and the Water Power Company called for the sewers of each street in the filled-in Bay to drain into one main which would discharge sewage directly into the Charles. He very much objected to this, feeling that such a volume could not be absorbed by the River at one location. Better, he said, to have a sewer at every other street discharge into the River, so that the reduced amount could be carried to the middle of the stream and then out to sea on the falling tides.

The remaining years of the 1860's were taken up with the acquisition of drainage rights in the new sections of the City, the constant replacing of old wooden pipes, and of man hole covers (some were still made of oak). The City could hardly keep up with the demand for new sewers and the growth of the City often depended on how much time it took it to satisfy the appetite for more and more of them. Buildings were continuing to be constructed at too low a grade and consequently cellars flooded at severe high tide. The problem was particularly acute in the area running from Copley Square to Shawmut Avenue. The Superintendent insisted that he license those mechanics who were going to build the sewers, since once built, they became the responsibilty of the City and poor construction caused many a headache.

There still was not unity among the three parties to the building on the Back Bay as to one large or several smaller sewers and the Superintendent urged a Commission to study the subject. He was constantly over his appropriation and just as constantly going and receiving additional funds from the Finance Committee of the Council.

The City's death rate, theretofore exemplary, began to climb and the physicians attributed it to the horrid effluent being dumped into the harbor and rivers, or not being disposed of at all. Yet the flow of raw sewage continued, indeed increased. When Atlantic Avenue was constructed, contradicting his previous insistence that several and not one sewer discharge into the less fragile Charles, Smith built one large one to take all the drainage from the area on the theory that it was better to make but one area of the harbor putrid instead of many.

The flats of the Charles River Basin were fast becoming an open cesspool and on summer nights when the wind was in the right direction, and of the proper strength, and the tide low, a stink enveloped a large portion of the City. Several leaders attributed the increasing defection to the Suburbs to it. The drainage situation in the South End contributed to the problem. The land naturally sloped toward the Back Bay, or empty basin, which was not always empty. But the water level was kept at three feet so that the waste from the mills, as well as the sewage from the district could empty into it. The City, which

owned much of the land in the South End, began to sell it off in 1845. As the land became occupied with homes, supplied with Cochituate Water and water-closets, the heretofore relative innocuous waste became stagnant filth.

In 1850-51, a large sewer was built running the whole length of Tremont Street to intercept the outlets of the cross sewers in the South End and run the drainage down Dover Street to the South Bay. This sewer was intentionally built very low so that it might discharge into the Bay during low water. A tide gate prevented the water from flowing back into cellars. But when the tide was abnormally high during storms, the system was designed to take the water the sewer could not hold and discharge it into the Back Bay. The filling of the Bay, however, eliminated all of these overflows and even a waste weir built to the Bay did not help since it, in consequence of the building, was now too lengthy to be effective. There were 1,142 cellars between five and ten feet above the low water mark which would be flooded in the event of a very high tide.

The Committee of Aldermen who considered the problem in 1868 dismissed the idea of building a large new sewer to take this overflow and hold it until the tide was low as too expensive. They also ruled out the idea of pumping the excess water to a level above the high tide, being ~~weary~~ wary, as were the planners of the Water Works, of the dependency on such a method. They finally concluded that the cellars could be kept dry by removing any connection in them to the sewer system and by boxing them. They

also recommended that the territory between Dover Street and the Albany Railroad should be raised to a sufficiently high level to drain independently to South Bay by a separate system of sewers, and leave the rest of the area the full use of the large sewer in Tremont Street and the other in Dover.

As far as the identical problem, buildings on low grade, in the Church Street area, a Commission was formed and authorized to spend not more than $650,000 to raise the buildings and grade of the territory.

By 1873, the Superintendent of Sewers was able to report that the City had 123 miles of sewers in its system. In his 1872 annual report, the Superintendent, W.H. Bradley, addressed two questions. The first, was the discharge of sewage into the River and Harbor shoaling these waters as some, concerned with navigation, maintained it was, and secondly, could not the sewage be used for fertilization, thereby eliminating the discharge into the waters entirely?

To the first, the Superintendent deferred to the reports of the Harbor Commissioners and of the U.S. Engineers. Neither had, nor could they, find any evidence that the shoaling was a result of the discharge of sewage. Indeed, the Superintendent maintained, "large spits have been made by ashing from the islands, and shoals have formed in Charles River by deposits from its currents, and by obstructions of bridges, but hardly a trace of sewage matter is ever deposited beyond the ends of the wharves, or can be found in the Harbor."[1]

[1]Boston City Document No. 92-1872.

To the second question, the Superintendent replied that no effective way had yet been found to separate the beneficial matter for the sewage from that which wasn't. That in order to have a sewage farm, most of the water had to be removed and since Boston's sewage was heavily water (the City's water consumption had reached twice the per capita use of London) the cost of removing it would be prohibitive.

The Great Stoney Brook which ran through a large part of the City was being used by some as an open sewer and the City was forced to proceed to cover parts of it over creating a conduit.

The Sewer System of the City of Boston first growing haphazardly, then forced to catch up to the effects of the Cochituate Water, the Water Closet, the multitudes of immigrants, the annexation of Roxbury, Brighton and Dorchester, and the wrenching from the sea of great acres of made land, had never the time for forward planning or thoughtful consideration. Now on September 16, 1872, the Committee on Back Bay Drainage submitted a thoughtful and forward looking report to the Board of Aldermen.

Some sections of the City were by now very thickly settled. Ward 3 had a population of 268 to the acre. But Dorchester had only 3 and West Roxbury 1 and one-fifth. It was to this area, West Roxbury, Dorchester and Brighton, that the City would have to look to to house its expansion. The Committee turned its particular attention to the West Roxbury and Brighton Districts, an area larger in size then the City proper. The Brooks emptying

into the Muddy River drained an area of about 2,600 acres, one larger brook draining the territory as far as Chestnut Hill and the smaller draining the territory as far as Jamaica Pond. The Muddy drained into what was at the time a part of the Charles River Basin, but which was to be filled in.

If the section then termed the City's suburb was to be developed, the drainage of the Muddy River had to be conveyed through sewers as would the human sewage. The Committee thought that a bad idea. The grade of Boston and Albany Railroad practically determined the grade at which such sewers would have to enter the basin, as the reconstruction of numerous bridges for street crossing would make the raising of the grade of this railroad very expensive. (The law required that there be a distance of 18 feet between the track and the bottom of bridges.). The grade of the sewer would be effective only at low tide and the system would face the same problem it did in the South End and Back Bay. Besides, the Committee pointed out, that the discharge of water (if two sewers - one for rainfall and one for human sewage were to be constructed) into the Basin might be beneficial for the River, it was already taking a great amount of human sewage, not only from Boson, but Newton and Watertown and Waltham. Better they reasoned, to take the drainage to Dorchester Bay and discharge it, not in the Bay, but into the channel of the Neponset River, between the Bay and Commercial Point, where it would be subjected to the action of both the tidal currents and also the scour of the Neponset River.

The Committee pointed out in its concluding paragraph, that this drainage system would be provided, by necessity, to adjoining towns over which it had no jurisdiction. It suggested that the City and its neighbors join in dividing these drainage areas into suitable districts, or "by which control, so far as the mutual interests of the city and of the towns, which relation to streets, water supply and sewerage, should be placed under commissioners having full power to devise and carry out such schemes as would be advantageous to the parties at interest."[1] (The suggestion, put forth by Assistant City Engineer Henry M. Wightman, was to come to fruition some seventeen years later with the legislative creation of the Metropolitan Sewer District.).

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[1]Boston City Document No. 92-1872.

Chapter XI

Many, beside the prominent physicians of the City, continued to feel that the raw sewerage being discharged into the harbor and which gave off such unpleasant odors at low tide, was harmful to the health of the City's inhabitants. To alay (or confirm) their fears, the Committee on Sewers was requested in 1873 to investigate the existing condition of the City's sewers and to ascertain if any improvements were necessary for the preservation of the public health. They were the wrong ones to ask.

Starting their report rather grandly, they said, "It is generally conceded that the rapid removal of decaying matter from the habitations is part of the necessary machinery and forms one of the conditions of life in large cities, and no doubt has a marked influence on the preservation of public health; but so varied are the conditions of life and so many the influences that should be eliminated before a comparision could be made, that no estimate in figures of the relations of sewerage to human life has ever been given."[1]

Conceeding to themselves that "there can be no question as to the perfect means enjoyed by our citizens in the collection and removal of sewage"[2] they turned to the method of its disposal. Dismissing the complaints of those who claimed that the City had no sewerage system at all or a bad system or no comprehensive plan, they declared that the City's system of drainage was as perfect, but not as complicated as that of any other City. They noted that

[1]Boston City Document No. 94. 1873.
[2]Ibid.

without any long lines composed of huge sewers or pumping works or flushing apparatus, the removal of the sewage from house to ebbing tide was rapid and complete; and "that is a perfect system."[1]

They stated that the awful odor eminating from the Charles River Basin was not caused by sewage, but by stagnent water on the exposed mud banks, a condition caused by the filling in of the Back Bay by the Water Power Company. Indeed, when fresh water was allowed to run in, the odors disappeared. To those who claimed that the large amount of waste being drained into the Charles was forming shoals and enormous mud banks in its chanel and the river would soon be as the Thames is in London, they haughtily replied that although Boston would some day rival London in size and population, the analogy ended there.

As for the Stoney Brook, which was by then the receptacle of the drainage from most of the breweries and factories of Roxbury, and which at Parker Street drained into the flats of the full basin, that basin is the property of the Boston Water Power Company which is rapidly filling it in. The gravel filling has kept so far ahead of house construction, that the residents of the new area hardly smell anything at all. Faultless themselves, they could nevertheless find some fault with the Street Commissioners. It was imperative, they pointed out, that when streets are laid in new territory, that the avenues should be laid out along the valleys of the various water sheds, in order that the main sewers of those valleys may be most advantageously located and constructed.

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[1]Ibid.

They have been embarassed by the necessity of taking land solely for sewer purposes (at a considerable expense) rather than wait in vain the action of the Street Commissioners.

The Committee on Sewers was equally displeased with the Water Board. Why, they demanded to know, did the Water Board insist on supplying a copious amount of Cochituate water to new households in the City's suburban limits, before they got there with the sewers? The soil in these areas was such that it could absorb the amount of well water used, but when the water pipes arrived, water usage surged, quickly saturating the soil, creating the uncomfortable and unhealthy condition of waste water without drainage.

It is not recorded as to whether or not the Water Board was intimidated, but the Board of Health was certainly not.

In a report to the Honorable City Council of December 17, 1874, they called the attention of that body to the conditions of the old Roxbury Canal, crossing under Albany Street; to the Stoney Brook Sewer, discharging upon the Back Bay flats; and the Muddy Brook Sewer, between Brookline Avenue and Downer St.

The tide in the canal was sluggish they pointed out, and the discharge of three or four sewers into it, leaves shallow water at low tide "through which the foul gases from the putrid bottom can be seen bubbling into the atmosphere."[1] It is so bad, they stated, that in the streets around there, there is a

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[1]City of Boston Document No. 18.

daily average of 230 patients who require pure air. They found equal nuisances at the other two points of discharge.

The Board of Health had no doubt that the prevalent summer diseases of the City were largely influenced by that poisoned atmosphere. If the sewage could not be retained and used but had to be discharged into the water and lost, it would be best, in the opinion of the Board, that large main sewers should be built to carry the sewage out to sea. As for which came first, the water or sewer pipe, they regretted that water pipes had preceded the laying of sewers, but they thought it fair to say that the supply of pure water had become a necessity and the people would have suffered without it.

In 1874, Superintendent Bradley was able to report that his department had laid seven and three-quarter miles of sewer, some of brick, some of pipe (iron, scotch and Arron) and some still of wood. They ranged in size from nine inches, to 78 by 72 inches. He had expended $232,832.63 and collected $105,794.78.

The Town of Charlestown had been getting its water from the Mystic Pond and after its annexation to Boston, the responsibility for that supply fell on the Boston Water Works. By now the streams discharging into the Pond were becoming polluted by the disposal of waste from factories and sewers. The City

wanted to build a sewer to divert these waters and preserve the purity of the Pond. The sewer would start in Woburn, run in a south-easterly direction through Winchester and into Medford and be discharged in the lower Mystic Pond, thus by passing the water supply.

The concern of the Board of Health was more convincing to the City Council than the assurances of the Sewer Commissioners. On February 23, 1875, the Board of Aldermen authorized the Mayor to appoint three civil engineers to report on the sewage of the City. The order was later amended to allow him, if he felt it expedient, to appoint two engineers and one person skilled in the subject of sanitary sciences.

As was the case with the investigations into a supply of pure water, Mayor Cobb (a quite popular man having been elected to office 19,191 votes to 568 for his opponent in 1873 and re-elected 16,874 to 835 in 1874) found three men of great distinction to study the matter, E.S. Chesbrough, C.E.; Moses Lane, C.E.; and Charles F. Folsom, M.D.

Ellis Sylvester Chesbrough had little school education before he was fifteen. He started work as an axe man on a surveying crew and ended as acting chief engineer of the Cinncinnati and Charleston Railroad. After trying farming for two years, he returned to Engineering on the construction of The Boston and Providence Railroad, and then became Chief Engineer of the Western Section (Cochituate to Brookline) of the Boston Water Works.

In 1849 he was named sole Water Commissioner for the new Works and in 1855 became the City's Chief engineer. But it was in Chicago where he accomplished the work for which he would be best remembered.

When he arrived in 1855, Chicago was a filth sodden town. Chesbrough raised the grade of the entire Town so that its sewage could be drained into Lake Michigan. He laid out the Chicago Sewer System, making it the first city in America to be systematically sewered. (The amount of filth carried into the Lake was so great as to endanger the purity of the water which was the City's supply. Chesbrough tunnelled two miles under the bed of the lake for a pure supply.). He also tunnelled under the Chicago River so that the traffic across it would not obstruct the navigation so necessary to the City's life. He was involved in every project so vital to that City at that stage of its existence.

Moses Lane was graduated C.E. from the University of Vermont in 1845. He spent most of the next years teaching, but was called by James P. Kirkwood, the chief engineer of the Brooklyn Water Works in 1856 to be his principal assistant. Joining Chesbrough in general engineering practice, he prepared plans for the water supply of Pittsburgh. In 1871 he was appointed Chief Engineer of the Milwaukee Water Works which he designed and constructed. He was called to Memphis, Tenn. to correct that city's drainage after yellow fever epidemic and constructed the water works of New Orleans and Kansas City.

Charles Follen Folsom, M.D. was educated in the classical tradition and after graduating from Harvard in 1862, taught in Port Royal, S.C. for the Anti Slavery Society which later became the Freedman's Bureau. He decided to enter the medical profession and graduated from Harvard Medical School in 1870. (His studies were interrupted due to travel and ill health). Almost immediately he made a specialty of hygiene and mental disease , serving for a time at the famous McLean Assylum. Folsom lectured on mental diseases at Harvard Medical during 1879-82, and was an assistant professor there from 1882 to 1885.

He was equally accomplished in the two specialties of his practice, hygiene and mental health, and held a foremost place among the prominent New England practitioners. He was for eight years secretary to the Massachusetts State Board of Mental Health, and was a member of the first Metropolitan Sewer Commission. Folsom was an overseer of Harvard University from 1891 to 1903; a fellow of the American Academy of Arts and Sciences and of many other professional and learned societies. Folsom was a busy suthor, writing many papers and pamphlets dealing with hygiene, public health and mental diseases in clear, concise and convincing style.

The Commissioners started their book size report with dismissing out of hand any thought that the death rate of the city and its diseases were not caused by its poor systems of sewage. Noting that while ,when the city was about seven hundred acres, the drainage posed no problem because it was so much diluted in a vast volume of water, the growth of the City

in various directions and on reclaimed land necessitated the extension of a plan which is no longer suited to the needs of the City. The filling of the old Mill Pond made it necessary to extend the sewers in that district to the canal and when that was closed, the sewers were intercepted by a main which now discharges on both sides of the City. The outlets are higher than the central point of the sewer in Haymarket Square causing disruption in that whole drainage area.

The South Bay district contained so many old covered wharves, the Commissioners noted, that the tide actually ebbs and flows in some parts of it; when the odors from the sewage discharged in the closed basin formed by the Mill Dam and the Cross Dam became too offensive, the sewer was extended to the Charles River to keep it flushed and clean and the sewers had to be discharged on the south side of the city into South Bay, causing flooding in cellars during storms at high tide. Summing up that part of the report, the Commissioners pointed out that the City had now many acres of filled in flat land and as quickly as it was created, it just as quickly caused a problem of drainage, a problem which many Cities had had from the beginning.

As to the condition of the sewers themselves, while the modern ones were constructed of good material and well built, there was no pattern to them, often they were built in response to an emergency. There were, in the City proper, thirty-two independent sewer districts, the principle sewers of which were built in different years, often widely apart and discharging into separate outlets.

Directly under the manholes of the sewers (of which they noted there were enough to properly inspect the sewers) was a catch basin put there to prevent deposits that might obstruct the sewer. They can never be properly cleaned, the Commissioners said, and continually collect sewerage resulting in literally open mouthed cess pools. A system which would allow the sewage to be rapidly discharged would eliminate the necessity for them.

The Commissioners objected to the tide gate sewers of which the City had many since they were out of operation one half of the day. During the time that they were closed by the tide the sewage entering them built up leaving a slime on the sides of the pipes. At the time of the build up, noxious gases also built up and could be discharged from household faucets, expecially if heavy rain accompanied the high tide.

Some of the fault, they wished to add, was not that of the City's sewer system, but of house drains and cess pools and privies. Cess pools and privies might still be necessary in some parts of the City and when built with cement walls and properly cleaned (by the pneumatic method) are not harmful. But if not properly built or cleaned, or filled in when they are no longer needed, they are a danger. As for house drains, they are sometimes made of pervious or ill-joined material allowing contamination of the soil and afterward of the air. If they are made of lead pipe, they often corrode and finally become perforated, allowing the discharge of sewer gases.

As to the filled in land, that of the old Mill Pond and the South Cove and large portions of the area between Dover and Northampton streets is of material not suited for building on. It is porous and allows water to percolate through rendering at least all the basement unfit for dwelling. While the Back Bay proper was filled with the best material possible, and the water level in the soil is uniform, the water, nevertheless, is too near the surface, creating serious faults of drainage.

There appear, the Commissioners noted, only two methods open to the City to alleviate its problem. One, raise more than one-half the superficial area of the City proper, which would be prohibitively expensive and the second, a system of intercepting sewers and pumping. Before going into their plan in detail, they proceeded to look at the final disposal of the sewage and the positions of the sewer outlets.

Neither precipitation of the solid parts with a view to using them as manure or disposal by irrigation seemed the way to the Commissioners. The method the Commission recommended was that used by all cities near a great body of water. Carrying the sewage out so far that its point of discharge will be remote from dwellings and beyond the possibility of doing harm. Sounding like previous commissioners in previous reports about another problem, they said "The work will require a large sum of money, but no larger than has been expended by other cities for the same purpose; only two-thirds as much as the City of Frankfort on the Main has lately appropriated for their sewers, and a small sum when we consider the benefits which will come from it."[1]

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[1]City Document No. 1875.

As to the place of disposal of the sewage, (At this juncture of the report, it becomes clear that the three Commissioners were not making a report on the sewage of Boston alone, but of the Metropolitan District. It would do no good if Boston strived to keep the sewage out of the Charles River or far from the shore of Massachusetts Bay if other Towns were still dumping in the River and into the Harbor), placing floats at six different places and following them as long and as best they could, would help determine the spot where the sewers should be discharged.

If the discharge was to be from Commercial Point, City Point or the Charles River below East Boston Bridge, sewage would be in large quantities even if discharged on the ebb tide, so it would return in considerable quantity by the next flood.

As far as discharging from Moon or Castle Island, if the discharge were done on the flood, the sewage would be deposited to a considerable degree on the flats of the Charles and Mystic Rivers or the Dorchester Bay and Quincy Bay flats, but if discharged at and immediately after high tide, it would generally go as far as Bell Buoy or Boston Light, with a certainty of not being a source of nuisance by the returning tide. The discharge there would be for the Cities lying south of Boston.

As far as the cities lying north of the Charles River, the only place that the sewage would be carried from the northern outlet out to sea by a rapid current was Shirley gut.

As far as the intercepting sewer was concerned, it would discharge all the sewage from that part of Boston situated between the Charles and Neponset at the North End of Moon Island. The main intercepting sewer would be located in nearly a direct line from Cottage Farm Station to the Neponset River near Savin Hill, to cross the river by a siphon, then to a sewer to be built along Squantum Beach and across Squantum Point to the end of Moon Island.

The grade of the sewer at Cottage Farm Station would be one foot below low tide, and the fall to Moon Island, twenty-five inches per mile. The sewer would be circular, nine feet in diameter until it reached Albany Street, nine feet by eleven (equal to a circle ten feet in diameter) from there to the pumping station and from the pumping station to the outlet at Moon Island, at first ten feet by twelve (equal to a circle of eleven feet in diameter) and finally twelve feet by thirteen thus enlarging the storage capacity of the outfall sewer.

The siphon under the Neponset would be six feet in diameter and fifteen hundred feet long. While it was proposed to build it of wrought iron, properly protected from salt water, further surveys and borings might show that it would be more permanent and less expensive to build a brick tunnel laid in Portland cement with iron ribs to strengthen the masonary. Chambers would be placed in each end of the siphon for connecting a second one if ever needed. At the outlet of Moon Island there would be a reservoir to hold twenty-five million gallons, somewhat more than the usual amount of sewage discharged in twenty four

hours. The discharge would take place at each tide for two or three hours after high water.

They proposed to erect at the pumping stations three engines of 145 horse-power each. A very liberal provision for the present, but in view of the free use of water after the completion of the Sudbury aqueduct, it was thought best to do it that way. The sewer would drain all the City lying between it and the Charles; and all that part of the City between south of the new sewer below grade forty. It will be large enough to drain twenty square miles and to take the sewage of a population of 750,000.

The size of the outfall sewer would be sufficient to carry the sewage from a population of one million and also one-fourth of an inch rainfall per day. It would have a capacity of over two hundred and eighty million gallons a day. (All this was based on the assumption that the amount of sewage was seventy-five gallons per day per inhabitant.)

The Commissioners also wanted it understood that the natural water courses in Dorchester, Roxbury and Brookline were to be kept open, especially Stoney Brook and Muddy Brook, and free from sewage and their chanels straightened. It would be impossible, the Commissioners thought, to build a sewer large enough at reasonable cost to carry off those waters in case of storm. The recommended that the sewers be flushed periodically as was now done with the sewers of European cities.

The cost of the sewers recommended for the south side of the Charles River would be $3,746.500. and for those of the district north of the Charles, $2,804,564.

(There was an immediate remonstrance to the plan by twenty-eight citizens. They objected to the cost, questioned the need, and doubted the pumping station).

On June 12th, the Joint Special Committee on a System of Improved Sewage for the City of Boston reported its response to the Commissioners recommendations. A serious mistake was made it conceded, by fixing at too low a grade those portions of the City whcih had been reclaimed from the sea. Since the sewage had for so long been discharged into the basin (Back Bay) and the grade of much of the Town has been geared to that, the filling in of the basin had resulted in the grade of some of the City being too low. The problem had been rectified in the territory of the Church, Suffolk and Northampton districts at the cost of several million dollars. The nuisance had not been abated however, but only transferred to some other parts of the City, the drainage going through tide-locked sewers which emptied at some different points along the waterfront, frequently depositing the sewage on the flats at low water, causing an intolerable stench.

Pointing out that the drainage was discharged at 100 points along the waterfront, sometimes at low tide where it would settle on the mud and sometimes at flood tide where it often washed back in, the Committee reminded its readers that the sewage had so built up in the Roxbury Canal that it became necessary to dredge there. That the stench and nozious gases

eminating from the sewage were a source of ill health, they had no doubt. They traced the course of the proposed intercepting sewer on the north from its start in Cambridge at the north end of the approach to Brookline bridge, through Waverly Street to the Boston & Albany Branch Railroad, to Charlestown, thence to Cambridge and Alford streets to the Mystic River, crossing both the Mystic River and the Chelsea Creek by a siphon to Breed's Island and across the island along the northerly foot of Breed's Hill and another siphon across the inlet to Winthrop and finally to an outlet at Point Shirley.

The plan, they said was bold and expensive, but boldness was needed and the more than $3,000,000 that it would cost was not too much to pay for the relieving of such a danger to the health and welfare of the City and its inhabitants. They recommended the adoption of the plan of Chesbrough, Folsom and Lane.

On July 12, 1877 the City Council passed an order authorizing the City Treasurer to borrow the sum of three million seven hundred and twelve thousand dollars. The plans for the improved sewer system had been drawn by the City Engineer, Joseph P. Davis and the necessary authority obtained from the Massachusetts Legislature in Chapter 136 of the Acts of 1876. But the City Engineer took liberty to change some of the Commission's plans, and to consequently to increase the scope and cost of the project.

Engineer Davis declaring it did not seem in variance with the spirit of the Commissioners'report, considered four points for the discharge of the drainage; Spectacle Island, Thompson's Island, Castle Island and Moon Island. Because he

was wary of where the sewage would end up and distrusted the topography, he ruled out Spectacle. Neither did he and the Joint Committee think Thompson's Island was a favorable place for discharge.

As far as Castle Island was concerned Davis felt that permission to use that land, which was owned by the Federal Government and was the first line of defense of Boston Harbor, would be too difficult. He therefore settled on Moon Island as the point for discharge, declaring it far enough away from any present or prospective population, with strong currents which would take the discharge safely away. The total cost of building the interceptor sewer system would be $3,429,000.

On July 25, 1877, the Common Council executed the necessary documents to take land in Medford, Winchester and Woburn it was authorized to acquire by the Legislature for the Mystic Valley Sewer. On January 28, 1878 it did likewise for some marsh land in Old Harbor Point in Dorchester, from whence the sewer would run out to Moon Island.

The building of the sewer, except for one section in the Back Bay was to be let out for contract. There was considerable agitation on the part of unemployed men living in the City that the contractors were hiring people from outside the City at unreasonably low rates of wage, thus depriving them of work and forcing down the pay of those who did have work. In response to the criticism, the City decided to build section 4 itself, using the machinery and expertise it had acquired in building the section in the Back Bay. They would use day labor. The building

proceeded at a good pace. In August of 1879, the City took the necessary lands at Squantum in Quincy and Moon Island.

By 1880 the City had 197.5 miles of sewers, the Superintendent reported, as he did almost annually, that his appropriations had run out and he needed more money. The Ordinance of 1876 governing sewers in Boston was amended so that if any owner connected his drain to a common sewer from land which had not been assessed, he would have to pay two cents a foot up to 125 feet, but when his land was assessed, that payment would be deducted from the assessment.

The struggle to unpollute the Mill Pond continued and in 1883 a new outlet was put into the Charles River to take the drainage from what was known as Miller's River to be discharged by the Prison Point Bridge in Charlestown.

Cochituate water had arrived in the sparsely settled Dorchester section of the City and had caused, as it had in other sections before, a building boom. No drains existed in Dorchester and the earth was ill suited for cess pools. If drains were to follow the natural flow of Stoney Brook, in whose valley the section lay, five miles of pipe would have to be laid to reach the nearest sewer, which was in Jamaica Plain. In his annual report of 1883, the Superintendent listed the footage of accepted streets which had no sewers. The length ranged from 15, 650 in Brighton o 262,270 in Dorchestor. Because of the variable conditions of the streets he could only estimate the cost of laying sewers at $3.50 per linear foot, of $3,300,013.for the 945,435 unsewered streets.

Up to this point in time, the superintendency of the sewers, both building and maintaining, had been held by the Board of Aldermen. But Ordinance dictated that the charge of City Property, and completed sewers had been ruled such by the Supreme Judicial Court, was the joint business of the Aldermen and Common Council, the City Council. It was decided that the Aldermen would remain in charge of the construction and the City Council would have jurisdiction over maintenance. The City Council would annually vote for a superintendent, who, it was hoped, would be in charge of the duties of both construction and maintenance.

While the building of the needed system of intercepting sewers had accomplished much of what it was hoped it would, there was still a great deal to be done in the system. Old wooden sewers still existed, particularly in the North and West Ends and they were continually leaking. The wooden flume from Squantum to Moon Island was, in the opinion of the Superintendent, the weak point in the system. He feared that it was liable to burst at any time and cause an enormous nuisance along the shore. He wished to build a new conduit in its place.

The changing political control of the City is apparent in the positive response of the Mayor and Alderman and Common Council to Superintendent Thomas J. Young's request for more money. The order increasing his salary from three thousand five hundred dollars to five thousand was signed by Patrick J. Donovan, Chairman of the Board of Aldermen, D.F. Barry, President of the Common Council, Hugh O'Brien, Mayor and J.H. O'Neil, City Clerk.

The amount of work done by the Sewer Department in 1886 and 1887 far surpassed that done in any similar period and as the sewers were laid and the water mains built, building was sure to follow. In one section of Dorchester, the number of houses increased from scarcely a dozen to several hundred first class residences after the arrival of the water and the sewers. The rapid progress in building sewers, however, created problems. The Sewer Department found itself constantly under-funded and great pressure was brought on Mayor O'Brien by the enterprising builders of the City. The Mayor pointed out to the City Council in September of 1887, that there was $862,699 in the City Treasury for a variety of purposes of which no more than $30,000 would likely be called for that year and urged some of those funds be transferred to the Sewer Department.

Pollution continued. Upon the petition of several prominent citizens of the Ashmont District, who claimed that the lack of proper drainage had contributed to the death of several children, the Sewer Department built one and had it empty into the Neponset River.

In January of 1888, Mayor O'Brien received a letter from Mr. Francis A. Osborn, Chairman of the Civil Service Commission, noting that the Superintendent of Sewers had twelve men in his employ who had not been certified by the Commission. In reply to the accusation, Superintendent Seth Perkins went to see the Commission and convinced them that he must have the men or his vital work would be hampered. They reluctantly agreed and told him that if he would send his "aids" as he called them by, they would certify that they could find no one on the Civil Service

Rolls qualified for the job that they were doing. Five came by and were certified, but when the other seven appeared on a subsequent payroll, the Civil Service Commission informed the Mayor of the alleged illegality.

In response, the Superintendent said that he was trying to obey both the letter and spirit of the then experimental law, and that since the Commissioners could not, to his knowledge, supply the men he needed, he hired twelve young men to do such things as take measurements by rod, gauge, or tape, keeping accurate records of same, etc. Jobs the laborers on the Civil Service list could not do, Perkins maintained. As why only five men came by to be certified, the explanation was simple, the other seven had completed the task for which they were assigned and had been let go. That they were still on the payroll book reflected work they had done and not as yet been paid for. The Board of Aldermen were satisfied and ordered the Civil Service complaint laid on the table.

Chapter XII

The time, money and energy spent on the building of the very successful improved sewerage (Main Drainage Works), and the almost insatiable demand for sewers in the developing sections of the City, had led, in the opinion of the Superintendent, to the neglect of many of Boston's old sewers which he was sure, decreased efficiency of the whole system.

In his report submitted to City Council on January 28, 1888, he listed the present conditions of the sewers in each district of the City and the work that had been done the previous year and what was to be done in the future.

The East Boston area had been furnished with sewers in about nine-tenths of its territory, and while these in the uplands were in good condition, those in the lower section were not. Mostly built of wood, they had sunk and had been badly disordered and were constantly filling with silt. They discharged directly into the water, making the docks filthy. Since they did not have tide gates, the water backed up the sewer when the tide came in and often flooded cellars. That problem, he noted, could not be entirely obviated, even with a system of low-grade intercepting sewers, and he urged that the law that no cellars or basements be built below the elevation of high water be strictly enforced.

Two large wooden sewers had been replaced with ones substantially built of brick. He felt the plan of the Metropolitan Drainage Commission that would have the City build intercepting sewers which would convey the sewage to a point

on the southeasterly end of the Island and pump it to a discharge main extending to Bird Island Flats should be implemented.

The situation in Charlestown he found very bad. Most of the Sewers, or more properly drains, had been built by private parties for their own needs, and in many cases no records of where they were existed. Those that could be found were never meant to be sewers, just drains, and now they were being asked to be something they were not. Many were made of brick laid dry (without mortar) and the bricks protruded catching all sorts of material. These were most difficult to clean, the manholes being so far apart (if they existed at all) as to preclude the use of rods.

In 1887, the Superintendent reported, two thousand four hundred and sixty five feet of sewers were built. A small amount but the construction resulted in two important improvements. One of the sewers eliminated the discharge under the Chelsea Bridge by extending along the Navy Yard wall a distance of 830 feet where it could discharge into a current. The sewer in Bunker Hill Street was too small to carry the storm water of the thirty six acres naturally coming to it and cellars were being flooded. A new and larger sewer cured the problem.

The trouble that each Superintendent had from the Back Bay and other filled in land visited this Superintendent also. As land was filled, wooden sewers were laid with no precaution against settlement. They had settled and many functioned only partially and some not at all. These sewers must, Superintendent

Charles Morton stated,all be replaced.

The same condition of out of repair wooden sewers obtained in South Boston. In Dorchester, the small branch sewers and main sewers constructed some years ago in the more populous parts of the district were in good order, but the sewers in the portion of the district newly developed were too small. The problem lies in the lack of planning for future growth. While the sewers were large enough when built, the constant adding to them of lines rendered them too small. One sewer in Commercial Street had a territory of 710 acres which would naturally drain into it and that large area was increased 760 acres by the construction of a tunnel through Centre Stree and over into the Stoney Brook Water shed, to take the drainage from land as far as Blue Hill Avenue and Oakland Garden.

Morton predicted that the ultimate development of Dorchester will involve the extension of the interupting sewer, now built as far as Commercial Point, up the Neponset Valley, to intercept the sewage now emptying into the Neponset River, and to take care of the upper districts when they shall be supplied with sewers. No satisfactory disposal of the sewage of that part of Dorchester, he continued, bordering upon the Neponset River can be had until that sewer is built.

Unlike his dissatisfaction with the sewer system in other parts of the City, Morton was most pleased with the conditions in Roxbury, commenting that the sewers were well built of either brick or pipe and well designed. Attention had been paid to making

their size correspond with the amount of sewage to be carried. The main sewers followed the line of old brooks which had been filled up, and the water which had formerly flowed in them was now flowing in the sewers. With the exception of extensive changes that must be made in the sewers of the Ward Street district because of the removal of the main sewer from Parker Street, no new work of any importance would be needed for a number of years. The number of small sewers ordered to be built by the Board of Aldermen, Morton remarked, had not been done owing to lack of appropriation.

All sewers in the Brighton area were relatively new, the district having no sewers prior to 1878, but they too were constructed too small and without regard to the drainage areas. The value of land there had increased so much that the owners wished to get theirs on the market immediately. To that end they planned to fill in all marshy areas and constantly asked the Superintendent for permission to drain into the sewers. It would be impossible to admit the brooks and the consequent storm water into any sewer in Brighton constructed prior to this year, he maintained.

As for the future, the outlet sewers which now empty into the Charles are intended to be interrupted by the Main Drainage sewer for the Charles River Valley and that work should be prosecuted during the present year.

The Superintendent found West Roxbury, in comparison to its size, almost bereft of sewers. There was a main sewer built in Washington Street as far as Roslindale, but very few tributary sewers had been constructed. Some of the area would not need

sewers for some time, but others should recieve them soon. Morton told of repeated complaints from the Board of Health about the lack of sewers at Anawan Avenue, Highland Station, Central Station and several other places. But because of lack of sufficient appropriation, nothing could be done. To reach the districts needing sewage, long lengths of expensive main sewers must be built in order to connect with the present main sewer.

The problem of bringing the sewer system to the very large area which is West Roxbury, the Superintendent explained, is governed by the capacity of the existing sewer on Washington Street, which runs up to Kittridge Street, and the future course to be pursued in regard to Stoney Brook. It is evident that Stoney Brook must always continue to be the great channel for the conveyance of storm water in West Roxbury. The money spent on the so-called improvements of Stoney Brook from 1880 to 1884, was just money thrown away, Morton contended. Not only was the work started at the wrong end and the widening and deepening of the brook done only in West Roxbury and Jamaica Plain so that a flood of water fell down to Roxbury, but no intelligent plans were made for Roxbury where several miles of brook are walled in a channel much too small.

After exhaustingly reviewing the options present for controlling the flooding that occurs in West Roxbury and Jamaica Plain during heavy rain, Superintendent Morton turns his attention

to the subject of ventilation. The system then existent was simply to have holes in the covers of manholes, so that sewer gas could escape from them. If the covers were located in front of a dwelling, complaints would surely follow and demand that a closed cover be substituted. To the suggestion that the sewer be ventilated using the same system as is used for subways, he reported that that method had not been tried and proved. The assumption of certain data, such as the requisite velocities, volume of air needed, co-efficients, etc., has, Morton believed, to be made from the data gained in the ventilation of mines with certain modifications.

His own investigations of the matter made him conclude that there were only two proper methods of ventilating the sewer system. (1) a number of small vents which would be carried above the house tops by means of pipe ventilation, or (2) the establishment of a ventilating plant at the outlet of a system, as being the only point capable of furnishing a single vent for the whole system.

The first method, while perhaps the best, since it would cause more rapid changes in the air in the sewers, would be very expensive. The second, not withstanding the fact that it would require considerable power to reverse the natural flow of the gases, could be operated at a comparatively small expense. This method could be readily adapted for the Main Drainage Sustem by locating a plant at the Old Harbor Point Pumping Station where there are all the appliances for the manufacturing of steam present.

Superintendent Morton concluded his lengthy and detailed report with a discussion of a problem which had plagued the system since its inception - sewer assessments.

The method of assessment then in existence was based on the size of the sewer being drained into and the actual cost of building the sewer, factors, terrain for instance, making such cost variable. Mortion objected to it and suggested that a uniform rate per square foot of land benefitted, or a uniform cost per linear foot of sewer could be established, based upon the average cost of sewers already built, which would yield and amount equal to the revenue to the City and be more equitable and satisfactory to those assessed.

Morton conceded that the question of assessments was an important one and suggested a special committee of the Committee on Sewers of the Alderman, the Corporation Council and the Superintendent of Sewers, to take the matter under consideration.

CHAPTER XIII

The water had indeed arrived, but the Boston Water Works were far from completed. Upon the shutting down of the project for the winter of 1848, the Water Commissioners reported that the Reservoirs on Beacon Hill and on Telegraph Hill in South Boston had as yet not been completed, the distribution pipes in South Boston and in a few streets in the City Proper had not as yet been laid, and a large portion of the service pipes in Boston had not as yet been done. Still, they hoped that all would be accomplished by the close of the coming season, hopefully by the 1st of November, 1849. The law which created the Water Commission stipulated that the service of the Commissioners would terminate three years after the Act became effective or upon the completion of the works, whichever came first. It also allowed for extension of that body if the works took more than three years. Early in 1849, the Commissioners asked and received from the City Council an extension of eight months.

Although the works were incomplete, the Commissioners and the City Government were convinced that the problems of an adequate supply of pure, fresh water into the City had been solved for many years to come. They could not envision any other result from the long and arduous effort. They were wrong. Rather than being an end, even one temporary, to the supplying of the City, it was barely a beginning and the City would struggle for the next forty years in an always precarious and sometimes desperate effort to keep up with an astounding growth in demand for the water, a combination of unprecedented growth in population and scandalous waste. Boston's daily per capita use of water would become the highest of any city in

the world.

Those who lost the battle to have the city select the source they thought best, were, in the end to win. For the sources now disregarded, and others, would eventually be tapped.

The cost of the works now was exceeding even the most pessimistic estimate of those who most feared its economic effect on the City. They proposed that the building of the Reservoir on Telegraph Hill be postponed so that the debt would grow no further. The Commissioners said no, the Reservoir on Beacon Hill, as large as it would be, was not large enough to supply the whole City, and if a Reservoir was to be built in the old part of Boston, its cost would be much greater than on the cheaper land in South Boston.

The Commissioners were still having trouble in settling some claims for damage on property they had taken by their power of eminent domain, and asked the City Council to go to the Legislature to get permission to allow them to go, in the case of those who would not settle, to the Court of Common Pleas, there to have a Commissioner appointed to determine the proper amount of damages.

So far, they reported, they had spent $3,448,762.85 and estimated the cost of completing the two reservoirs would be $537,212.00. As in other sections of the city, East Boston was growing as immigrants continued to flood in. By 1849, the population stood at 9,130 - 1,780 families living in 1,217 houses. Their need for water could no longer be ignored. Mr. Chesbrough was asked to determine the best route and estimate the cost. He picked several as satisfactory, all of which would take the water by iron pipes, supported on

wooden piers, across the Charles and Mystic rivers and the channel between Chelsea and East Boston. His estimation of the cost was $397,508.02 (because of the necessity of crossing the water, he added 20% instead of the usual 10% for contingencies and the cost would be held down by the gift of the East Boston Company of an acre of land sufficent in height for a reservoir). The council approves an appropriation of $400,000.00, and felt the project should go ahead despite the obstacles it faced.

From its relatively humble conception, the Beacon Hill Reservoir was becoming a massive work. It was 199 feet, three inches on Dearne Street, 182 feet, 11 inches long on Temple, almost 192 on Hancock and stretched over 200 feet on Mt. Vernon. The foundation which would support the basin and thus the water was almost finished. Its lateral walls which would retain the water would be 12 feet with the face of the extension walls on the street. The Reservoir would stand over 15 feet high and the basin would hold to 2,678,961 wine gallons, and its main horizontal section would equal 28.014 square feet. The level on the top of the water would be 122½ feet above marsh level, or the high water mark, and run about 7 inches upon the 20 inches of coping at the top, or 14 feet, and 7 inches above the bottom of the basin. The minimum level of the Brookline Reservoir would be 2½ feet below this line.

Before the end of the year after the water had arrived, the Commissioners were able to report that they had laid 75 miles of pipes, ranging in size from 4 inches to the 36 inch main from Brookline to the City, including 11,483 service pipes laid in Boston, and

1,005 in South Boston. 10,851 taps had been opened and 1,637 applicants for the water were waiting to have theirs done. 662 fire hydrants had been attached to the works in Boston and 88 in South Boston.

The scheme to compensate the owners of the Middlesex Canal and the mills along the Concord River for their loss of water as it was taken from Cochituate seemed to be working. The two compensation reservoirs, White Hall in Hopkinton and Fort Meadow in Marlboro, in which surplus water of the winter and spring had been stored, were opened in June, and the discharge of water gradually increased as a drought worsened, until on July 26th of 1849, it reached a discharge of 40 cubic feet per second.

The East Boston section of the works proved no exception to history and the estimate of its cost had to be raised. The Commissioners were unhappy about being forced to construct pipes across the water but they had no other choice. The reservoir to be built in East Boston would hold four days supply, on the assumption that any break in the main across the water could be fixed in that time.

It was becoming obvious to the Joint Standing Committee on Water, that the Works, as then planned, would soon be completed and they turned to the task of restructuring its management. The Committee decided that the creation of a Water Department when the service of the Commissioners ended would be the best and most economical. They could find no examples of such a department in neighboring cities, so they travelled to New York and Philadelphia to have a look at theirs. They saw nothing they felt appropriate

for Boston. In both cities, the income from the water rents and other sources were running below the interest on the money borrowed to build the works.

In Philadelphia, the water was at hand, thus the number of men required to deliver it was small. New York, however had to go forty miles to its water and had a large force in its Water Department.

The Committee decided on an Ordinance creating the Cochituate Water Board, which would be given all the powers of the present Water Commissioners. The proposed Board would consist of one Water Commissioner, an Engineer and a Water Registrar, who would see to the clerical management of the Board. Each of the members of the Board would be chosen by the City Council and compensated to the extent the Council thought equitable. Their terms would run for one year.

They also appointed a Water Comptroller who was to take charge of the collection of the rents, and remit the same weekly to the City Treasurer. All others hired by the Water Board, they stipulated, must be citizens of the City and their appointment be approved by the Council. An order was passed asking how many men, not counting laborers, were now in the employ of the Commissioners and what was their compensation. Eighteen, the Water Commissioners replied, with their salaries ranging from $3,000. for the two Chief Engineers, Whitwell and Chesbrough, to $1.00 per day earned by the Lake Gate House Keeper.

The persistency of the Water Commissioners in seeing the Works

completed through years of opposition, delay, frustration and some times bitter argument, was in many ways herculean. Water would have come to Boston without them of course. Its arrival was inevitable, but much is owed to those men, Laommi Baldwin, Nathan Hale, Laommi's brother James F. Baldwin, Daniel Tredwell, R.H. Eddy, Thomas B. Curtis. Gifted men, many pre-eminent in their own fields, they gave of their energy and intelligence and risked their reputations to bring to the City they loved so much, that commodity the availability of which was now helping to turn Boston into a major City of the World - Water.

On January 5, 1850, with the Mayor and City Council in attendance, the three surviving Water Commissioners, Hale, James Baldwin and Curtis, submitted their final report to the Joint Committee on the Introduction of a Supply of Pure Water Into the City of Boston. They reported to Mayor Bigelow and the Committee that all important work, except the completion of the Works to carry the water to East Boston, had been finished. There were still, they said, some damage claims to be settled and equipment to be sold.

Ironically, those three foresighted men left the service of the City with a statement which would, much sooner than any of them could realize, prove totally inaccurate.

"The amount of water afforded by Cochituate Lake during the past year, although a season remarkable for its comparatively small quantity of rain and snow, has been sufficient to give the most satisfactory assurance, of the abundance of the supply which may be relied on from it, for all domestic wants of the City, at any future period."[1] The Lake was yielding, including some which was wasted

1. BOSTON CITY DOCUMENT NO. 3-1850

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into the Concord and Charles Rivers, 10,339,000 gallons on the average and who could imagine a need for any greater quality.

They totaled up their work.

Over 81 miles of pipe in various dimension from 4 inches to 24 inches.

13,341 service pipes to houses and places of business.

12,108 taps opened and 1,233 waiting to be opened.

1,292 feet of one inch pipe of lead laid on the wharves to service the shipping in the harbor.

779 fire hydrants in the City proper, 137 in South Boston.

The Beacon Hill Reservoir completed and water let in on the 17th of May (1849). It had been filled by means of a 30 inch pipe from the Brookline Reservoir, in the space of 18½ hours, and in 21½ had risen to the height of 4½ inches on the wasteway by which the overflow is discharged into the common sewer.

The total cost of the works (not including East Boston) was $4,039,826. less $41,774. realized from the sale of machinery for final cost of $3,998,052. The $4,000,000. cost that Mayor Joshua Quincy, Jr. predicted that the project would not come near, was just barely missed.

The Council appointed the men who had been the Chief Engineers of the respective Eastern and Western Division of the Works, Chesbrough and Whitwell, during its construction to the Cochituate Water Board along with J. Avery Richards as the Registrar. Chesbrough would be the Commissioner and Whitwell the Chief Engineer.

In 1850, the City ordered that all persons taking water must keep the service pipes within their premises, including any area

beneath the sidewalk, in good repair and protected from frost at their own expense; and further ordered that the water taker would be held liable for all damages which resulted from their failures to do so.

The Overseers of the Poor, petitioned the Water Board for a supply of water to the new Alms House built on Deer Island. The Chief Engineer calculated that the best route would be from the present termination of the six inch pipe in East Boston, across the Channel and then to the hill north of the Alms House. 18,000 feet of the pipe would be constantly wet and therefore would be made of wood, which is an almost indestructible construction, he pointed out, as long as the wood remains wet.

Except, one supposes by its Proprietors and those who still took water from it, the Jamaica Pond Aqueduct, seemed forgotten. The Water Board decided to purchase it, but the City Council objected to the agreement on the ground that only that body could enter into such actions. The Water Board politely differed, pointing out that the Water Act of the Legislature allowed the City Council to delgate any of its authority to its agents. The Council had so done with the Water Commission and all the powers of that body were subsequently given to the Water Board.

They defended the financial aspect of their impending purchase by pointing out the City would receive the revenue now going to Jamaica Pond Aqueduct. The whole number of takers from the Aqueduct Corporation was about 300 and the average annual water rent, $8.00. The Board planned to pay $45,000. for all the property of the Corporation (except some land in Boston). Included in the purchase

would be Jamaica Pond itself, a body of water of about 60 or 70 acres and containing 116,000,000 gallons of water of a height of sixty feet above the tide.

(The Board already had an offer for the Pond.) The Council, after consideration of the Board's plan, agreed that they had acted in the best interest of the City but should have informed the Council of the negotiations.

The authorities at the newly opened Charlestown State Prison approached the City Government there and asked for permission to run water pipes through the City to the prison. Charlestown saw this as an opportunity to get some much needed fire hydrants for no cost and agreed to let the pipes be laid if hydrants were placed along the line. When the prison authorities asked the Water Board of Boston to supply it with Cochituate water, the answer was no on the grounds that they doubted their authority to supply outside the City. The rejection also contained the first hint that the Cochituate supply might prove inadequate soon.

Pointing out that there was sufficient water at Cochituate now (679,209,300 gallons), they then stated:

"It is sufficiently obvious, nevertheless, that the time must arrive, and at no very distant date, when, if the consumption of water goes on increasing as it has been doing, the whole means of supply must be restricted to the City itself." The population of Boston they pointed out as of May 1, 1850, had grown to 48,573.

The Water Board soon discovered that, in the determination to get the Works built at the highest possible speed, that the Water

Commissioners had not created an authentic description of all the parts of the Works, and there existed no official statements of the mode of construction. To remedy the situation, the Board researched one of its own, describing the construction of the Boston Water Works in very great detail.

The Proprietors of Louisburg Square had been encouraged to make improvements around their property. One was to build a fountain on their common and to surround the common with an iron fence. The owners spent considerable money in doing the work and each of them was paying a yearly fee for upkeep. The city fathers who had encouraged the improvements were pleased, as was the City Assessor who felt the improvements added $2,000. to the value of each house on the Square.

The owners pointing our that one of the improvements they had been encouraged to do was the fountain said that they believed they had an agreement with the City, that if they laid and connected a pipe from the Reservoir, the City would find and lay the introduction pipes and grant free use of the Cochituate water, so long as an abundant supply should continue.

The City Council asked the Water Board if they would do it. The Water Board replied that, even without considering the expediency of the request, it had not the authority to give water away. If, it added, the Council felt they had such authority, then they could delegate it to the Board.

By October 1851, the average daily use of water in the City had risen to 8,451,259 gallons or more than sixty gallons for each

individual. This represented an increase since the previous year of over a million and one half gallons a day and over ten gallons for each individual. This had happened without a corresponding increase in water tenants.

There were several reasons, the Water Board believed, for such an increase. Some houses as well as individuals in different classes were using much more water than anticipated. This included hotels where there is a constant flow of water which is not necessary. It is not necessary and indeed illegal to keep water in water closets, they pointed out. Stables where a hose was allowed used a great quantity of water. Perhaps, the Board went on, meter should be placed to find out just who is wasting the water, and the rates certainly should be kept high to discourage waste. The Board had already placed Mr. Huse's meter in distillaries, sugar refineries and other places. The Water Board asked the Council to change the Ordinance which created it to allow for the placing of meters anywhere they thought advisable. The Board felt so strongly on the subject that they also suggested that malicious waste of water should be made a penal offense.

The Works continued to grow as did the City. On December 23, 1852, the Committee on finance reported to the City Council that they had negotiated a loan with Messrs. Baring, Brother & Co. of London in the amount of 400,000 pounds sterling at the rate of 4½%, payable in that City twenty years from October 1st. The $1,950,000 realized from this loan added to previous loans, made the total borrowed for the Works $5,187,671.66 and when due and payable, including interest, the total expended would be $5,568,587.89,

minus cash receipts of $185,000.00.

As the calls made over the years for the introduction of water had become more strident as its need grew worse, now the call for the elimination of waste grew louder, as the water use soared beyond anyone's expectations.

In his inauguaral address on January 3, 1853, Mayor Benjamin Seaver called the City Council's attention to:

"The reckless, and I regret to say, continually increasing wastefulness, in the use of water which seems to prevail almost universally." [1]

When the water was brought in, he said, an assumption was made that 28½ gallons or at the most 30 would be a sufficient supply for each inhabitant. That, it was thought, would be more than adequate for all the public, domestic and manufacturing purposes. It was also assumed that seven and one half million gallons a day would not be needed until a population of 250,000 was reached. Yet the use at the time was nearly forty nine gallons to each individual of the City. If the waste did not stop, cautioned the Mayor, the water would have to be refused to a certain class of taker and the City thus deprived of a large portion of its revenue, or another main must be laid from Brookline at great expense.

"Some of the consequences have now been stated," the Mayor continued, "and I would earnestly caution the City Council, and through it our fellow citizens, and everyone who has the means and opportunity of enjoying the blessings which an abundant supply of water, at so much cost, has been furnished, that the supply thought

1. Boston City Document 1-1853

amply sufficient for all necessary useful purposes, is of course limited to those purposes; and that the City's works are entirely inadequate to supply long, the present increasing and wasteful consumption of it".[1]

It was not until May 20th, 1851 that the Water Board could report the completion of the purchase of the Jamaica Plain Aqueduct Corporation, but in the essence all they had purchased was the Corporation's works. By that time the doomed Company was down to a mere 35 users in the City. The flow of its water was cut off at Tremont Street. Those Works represented one of the earliest attempts in America to supply water to many users from a central source through a system of mains and service pipes. Financially, it had its good and poor days and its demise represented the end of the ownership of Water Works by private parties. It had managed for 56 years to supply fresh and pure water to parts of the Town and City of Boston. Its Pond, today as then, a thing of great beauty, was eventually to form one of the brightest jewels in Frederick Law Olmstead's beautiful emerald necklace through the City.

The warnings against waste went unheeded, the consumption unchecked. By 1853 the average daily per capita use was 55 gallons. Again the greatest of any City in the world having Water Works. Rates to commercial customers were raised in hopes of stemming the growing use and the City Engineer was ordered to attempt to find the cause of the waste.

He went about his assigned task by measuring the use of the water in those four hours, midnight to four o'clock in the morning, when usage was assumed to be lowest. To his astonishment, the amount

taken was 885,000 gallons, or a twenty-four hour use of over 5,000,000. At first he attributed the suprisingly large amount to leaks in the systems, but a check proved this not to be the case. He then metered large users of water and found that one hotel had a daily consumption of 25,539 gallons for 58 days and another 17,441 for 70 days. After the meters discovered the large use, it dropped dramatically.

The overuse of the Works was beginning to affect the level at the Beacon Hill Reservoir, making the high service imperfect. At times the level of water stood at four and even as low as ten feet below the ground level of the Reservoir. What a calamity, the Engineer thought, if fire should break out when the head of the water was insufficient or when the water was not even attainable. It was time, he concluded, that the Council must think of another main from the Brookline Reservoir or the use of steam to raise a sufficient quantity into the reservoir for the High Service. Unable to control the waste, the City was inexorably marching to the point where it did not wish to go - finding an additional source of water. The Chief Engineer also suggested metering all water and charging a water rate in direct proportion to the quantity used.

CHAPTER XIV

Repairs to the Aqueduct were started and concluded in 1854. There was a problem of accretions in the pipes and they had to be cleaned out. It was felt by the Water Borad that their rate of growth had diminished, but that the precise origin of the build up had to be found and, if possible, the means of preventing it further pursued.

In their report of 1855, the Water Board stated that they believed the whole length of pipes of four inches and upward, now laid, including hydrant branches, had nearly completed the whole works within the City, as the streets and populated areas of the city then existed. One hundred ten and four-fifiths miles of pipe had been laid, 960 stop cocks istalled, 17,999 service pipes had been connected to the mains, and 1,210 hydrants built. An additional charge of one dollar to dwelling houses and a rate of five dollars upon each house where there was a water closet or bathing tub was imposed.

For the first time since it had been selected as the source of the City's water supply, a deterioration of the quality of the Cochituate water had been detected. The condition was universally prevalent and not only a source of much annoyance, but it also elicited concern for the welfare of the City. The condition was first noticed in October of 1855. To some it consisted of a peculiar fish-like taste, to the majority, however, it was the taste of cucumber or some similiar vegetable. The taste was sometimes accompanied by a disagreeable smell. The Board, at first, assumed

the problem was in the pipes and had them flushed out but the taste got worse not better. It was also observed that the mysterious condition disappeared from water that was left standing a few days after being drained from the works.

As they had more than once before, those concerned with the City's water turned to Dr. Horsford of Cambridge for help. He and Dr. C.T. Jackson of Boston were appointed to see what they could find out. They both concluded, after working independently of each other, that the impurity in the Lakes water was caused by the decomposition of vegetable matter existing in the Lake, probably brought about by the long and severe drought of last summer and to the subsequent rains acting on the peculiar soil of a part of the Lake and over the whole watershed. They both believed that the condition would clear up naturally.

On April 9, 1855, the Cochituate Water Board declared all the Works completed, nine years after the project had begun. All that was needed now was maintenance and connecting up of new customers. A year later they knew that they had been wrong. The daily draw from the Brookline Reservoir had grown to 10,436,300 wine gallons and the mains from it to the City were insufficient for such a supply. On some days demand was so great that head dropped as much as ten feet. The next year the Board reported that a new dam at the outlet of the Lake and an additional pipe of 36 inches laid 985 feet across the Charles River Valley had been completed. If the present rate of consumption, 12,726,072 gallons daily continued, the Board warned the present supply would

soon be exhausted. The Finance Committee voted to borrow $300,000. to construct an additonal main from the Brookline Reservoir and it was voted to increase the penalty for waste. (Hopper Closets had increased from 648 in 1854 to 3,215 in 1856).

The City Council's Ordinance against waste placed a two dollar fine on those it found unnecessarily wasting the water. If the waste did not stop in two days, the water was to be cut off and an additional two dollar fine imposed. For a second offense, the fine would be four dollars and if this were not paid, the water was to be cut off and not put back until the cause of the complaint was remedied. The charge to reinstate the water was two dollars. In 1858, the water rates were substantially increased, some even doubled. But nothing seemd to work against the mounting waste.

To a young Mr. Reuben Ware, the awful roar he heard on that March day in 1859, was inexplicable until he reached the spot where the iron pipes of the Water Works to the City of Boston crossed the Charles River Valley. A great avalanche of wood, stone, trees, and earth was being carried into the river by the water which until now had passed unseen through the pipes. The pipe crossing the valley had broken away from where it connected to the rest of the aqueduct and tons of water were spurting out. The young man had the presence of mind to run to his house and mount a horse for a dash to Lake Cochituate, where he informed Mr. Knowlton, the Gate Keeper, who promptly shut off the flow of water from the Lake. That prevented further damage, but a great amount had already been done.

The huge wall of debris had quickly blocked the river and already it was backing up, flooding the surrounding territory. And the frightening possibility that the complete break in the system of delivering the water might not be repaired by the time all water in the Brookline Reservoir had been used, thus denying the City any water at all, was a real one.

The stone gate house and nearly 100 feet of the brick conduit had been torn away and carried, with several connecting pipes, a distance of 75 to 100 feet. The Water Board immediately dispatched all its men to the scene. Work to repair the break began at once, but was severely impeded by a violent rain. As many men as were needed were found, and soon the small army was of a size that sufficient food and shelter could not be found in the vicinity. Many workmen had to be sent into the City at night and returned in the morning.

The Water Board had a bit of luck, though. Ordinarily its normal supply of pipe on hand would not have been sufficient for repairs but fortunately they had an extra supply of 30 and 36 inch pipe on hand, thus avoiding a delay in the repairs. The pipe was connected temporarily to a new gate house that would be constructed far inward from the old one on April 2nd, after five days and four nights of intensive effort.

The connection was made through one of the pipes and the following night through another. On the following Thursday, after thus assuring the City of its supply of water, a new gate house was constructed. The connections were made just in time, for the

task of shutting down the Works in the City and already begun, commercial users first. In answer to the Water Board's appeal, the households had cut thier daily usage from 9,000,000 gallons to 3,000,000 gallons (an indication as much as anything of the extent of the waste).

A Mr. Curtis was kind enough to allow the debris to be piled on his property until it could be carted away. The job of cleaning the River proved arduous and, not counting the cost of the pipe, the expense of the near disaster was $15,380.73.

(The Water Board had a Gold Medal struck and presented it to the quick-witted Reuben Ware).

The second main from the Brookline Reservoir to the City was completed and connected on the day before Christmas of 1859. It had cost $404,254.87 or $13.07 a linear foot for its roughly 23,000 feet of length. It worked well as the height of the water in the Beacon Hill Reservoir rose six feet over its previous average.

In their annual report of 1860, the Members of the Water Board were very pleased to say that "it seems as if we might now fairly conclude that the individual consumption of water had come to its maximum - the variation in three years not exceeding one gallon (per person) " 72¼ to 73 gallons. They were unfortunately wrong and had to report a "fearful example" by indicating the consumption in 1861 had risen to 97 gallons per inhabitant. A consumption that might be sustained if the rainfall at Lake Cochituate averaged its usual 55½ inches of rain each year, but if the rainfall should diminish to an average of 48 3/4, the supply would be inadequate, let alone the delivery system.

Willing by now to try all known methods of cutting down on waste the Water Board considered adopting the plan of the New York Works. This required City approval of all fixtures to be licensed and certified as competent by already licensed plumbers. It also required them to report each month on what they expected to install and be duly bonded. (The New York system also required the plumbers to be Native Americans).

In 1862, partially as a result of its inability to stop the waste, the composition of the Water Board was changed. It would be, from then on, composed of six civilians, two members of the Common Council and one of the Board of Aldermen. They were to serve staggered three year terms. The new Board was no more successful than its predecessors and in December of 1864, the water level at the Lake, from a combination of heavy draw and a dry fall and winter, fell dangerously low. A system of inspection of household plumbing and installation of meters was tried. Many fixtures were found out of order, the meters were far from perfect but worked particularly well, ofter cutting consumption of large users in half. A fact that led the Board to conclude that no less than half the water supplied the City was being wasted.

The 1866 annual report of the Cochituate Water Board was submitted to the Joint Committee on water on May 20th, to conform with the City's fiscal year which ended on April 30th. In it the Board reported that when the East Boston Reservoir's water filled above ten feet, it leaked. They, as yet, had been unable to locate where in any particular part of the puddle bank the defect might be. The Hopper Water Closets continued to cause

waste. Many owners of that device of convenience believed that in order to keep them clean a steady trickle of water should constantly run through them. The Board maintained that they would be more sanitary with one flush of one or two quarts of water. The Works once thought essentially finished began to grow again. It was decided to build another larger reservoir outside the City at Chestnut Hill in Brighton and Newton. When it was completed, the Reservoir in Brookline would be emptied, given a much needed cleaning and a leaky gate house fixed.

The Water Board did not escape the labor unrest that was fermenting towards the end of the nineteenth century. Although the Board maintained that their employees were well treated and well paid, without notice on March 2, 1867, 235 of them walked off the job. Their demand was for an increase in their wages which stood at one dollar and fifty cents a day. The Board, in their report to the Committee on water, claimed to have later found out that the fault lay in a few restless individuals. Within a few days, most of the men, many of whom lived quite close to their jobs and were respectable family men, were back of the job, the Board said, indicating the strike was a failure. Never-the-less, the daily wage was raised to one dollar and seventy five cents on May 4th.

$710,000. had been appropriated for the Chestnut Hill Reservoir and by November of 1867, $643,000. had been spent. The Board estimated that it would need $200,000. and an additional $200,000. for the planned 40-inch mains into the City.

The town of "Rocksburie", so called because of the abundance of pudding stone found there, was settled by men of substance, merchants and artisans from the Western Counties of England in 1630 or 1631. It prospered and was, in many ways, more historical than its larger sister across the narrow neck of land which perilessly connected it with Boston. After years of debate, those relatively few citizens who held the franchise, voted 1,832 Yeas to 592 Nays to allow the by then City of Roxbury to be annexed to the City of Boston. The annexation would take effect on January 6, 1868. One of the reasons that the annexation party won the day was was the knowledge that Roxbury could be tied into the Cochituate Water. What frightened some of the Water Board and other members of the Boston City Government was whether the Boston Water Works as they then stood had the capacity to supply the amount the new section of the City would require.

To determine just what the need would be, circulars were left at every house and place of business. One thousand and one said they would take the water, 390 said maybe. A general route was chosen to bring the water to Roxbury. A main would be connected to the present 36-inch main at the junction of Lowell and Washington Streets. A twenty-four inch main would carry the water through Washington, Dudley and Eustis Streets, to East Street, then branch off from that with smaller pipes, extending into those streets on the high ground where water was then most needed.

As a matter of economy, metallic grates, hydrants and service pipes would be put in as fast as the several mains were laid. The Boards asked for two appropriations, one of $200,000. to start and

and one of $250,000. to complete the proposed work.

The Board didn't get the money. There was much powerful opposition to an early supply of Cochituate water for Roxbury. The reasons given were the same as given in opposition to bringing the water to Boston and by some of the same men, for sections of Roxbury, particularly around Jamaica Pond, contained the summer homes of men of wealth of Boston. The Water Board confessed that the opposition stupified them.

But the opposition was victorious only temporarily and eight miles of main and two of service pipes were laid in the Roxbury Highland District and water was introduced on the 26th of October, 1868, almost twenty years to the day after it had reached Boston. A Reservoir was proposed on Roxbury Highlands but the use of stand pipes was becoming more popular. The Water Board went to Philadelphia to confer with the Chief Engineer of the Works there, Frederick Graff, and inspect a stand pipe being erected by him. They also visited the Chief Engineer of the Cronton Works in New York where Chief Engineer William L. Dearborn recommended the device.

The Board unanimously agreed that a Stand Pipe would be erected on a lot known as the "Old Fort" situated on Beech Glen Avenue on the south and Fort Avenue on the north. The base of the shaft was to be about one hundred and fifty-eight feet above the tide marsh level. The interior of the pipe was to be made of boiler iron, five feet in diameter, of equal size throughout.

The Chestnut Hill Reservoir had been completed, but the Board asked for another $500,000. to construct a water tight dam or

puddled embankment to protect the aqueduct and embankment, as the pressure of the water in the upper basin had cracked the conduit, and water was working the way through the embankment, undermining it.

So large a membership on the Board was now thought to be cumbersome, so the Ordinance creating it was changed in 1869 to a makeup of one member of the Aldermen, two of the Common Council elected annually by their respective bodies and two citizens elected to serve two years.

Water had still not been brought to Deer Island and the Board of Directors for Public Institutions urged the Water Board to do so, since the impending annexation of Dorchester would bring more "inmates" to the Alms House as other annexations had done before. The Board reported the Stand Pipe in the Highlands almost completed, with the pumping engines and boilers in working order. The grounds around the stand pipe were so laid out as to be accessible to carriages. It was decided to supply the High Service in Boston from the same Stand Pipe by making a direct connection. If successful, the head would be increased one hundred feet, bringing it almost to the base of the cupola of the State House.

The almost uninterrupted record of spending beyond their estimates which each Commission or Board of the Works compiled did not escape the Chestnut Hill Reservoir. By 1870 it had cost $2,277,616.00 and they needed, they told the Joint Committee on Water another $259,120.95 to complete it.

The year 1870-1871 brought with it a severe drought, so much so that the water level at Lake Cochituate was only 4 feet 10/12 inches. Two pumps were put into service to force the water into the conduit. And, though it was not their history to do so, the water users of Boston managed to conserve so that the quantity used decreased by 62,700 gallons a day. Rain, as it always had in this moisture rich section of the Country, eventually restored the Lake to its normal level.

Because the Boston High Service District was now supplied from the Fort Hill Stand Pipe; because the increased quantity of water used made its previous generous supply now only one fiftieth of days need and because of the impending 40-inch main directly to the City from the Chestnut Hill reservoir on Beacon Hill was no longer needed and the Water Board proposed to sell it. They felt the proceeds from the sale would be enough to pay for the main from Chestnut Hill.

The Cochituate Water Board was not the only such entity supplying water in the Metropolitan Area. The Mystic Water Board had been formed to supply the Town of Charlestown. When the City Council instructed the Cochituate Board to supply East Boston with a supply of water at the earliest moment possible, the Board replied that the annexation of Roxbury and Dorchester made them doubt that the Boston Water Works had the capacity to do the job. They suggested that they purchase water from the Mystic Board to supply both East Boston and Deer Island. Not only will this be more economical, they pointed out precluding an addition to the Boston Works, but the head would be far greater coming from the Mystic Lake than from Cochituate. The supply commenced in January of 1870 and, as a

condition of the contract until the water debt of the City of Charlestown was extinguished, revenues from the sale of the Mystic Water for East Boston and Deer Island must be used for the purpose of reducing that debt.

But not everyone supported the scheme. Many questioned why the City, which they believed had to have an abundant supply of water after spending so much on its Works, had to go to the large annual expense of purchasing some from Charlestown.

The Water Board knew that the supply from Cochituate was in real danger of proving inadequate, and soon. The only solution, was to find an additional source. They turned to the Sudbury River. Their plan, when the Legislature gave them the proper authority, was to take the Sudbury River and use it to fill Lake Cochituate, and then to build a new and independent conduit of liberal proportions to the Chestnut Hill Reservoir. They believed that they received the necessary authority just in time, since the pressure on the existing conduit which was not built to deliver the huge amount it now was, was being threatened with serious mishap, especially in cold weather when people ran the water to prevent the pipes from freezing up.

To do the necessary surveys which would determine the best route from the Sudbury to Lake Cochituate and thence to the Chestnut Hill Reservior, they sent to Chicago for Mr. Chesbrough. He cheerfully replied that he would be delighted to come. Since the Water Board was convinced this large new supply would forever, or at least for a very long time, satisfy all the needs of the City, they wished to start its construction immediately, and

could they have $500,000. as start up money, they asked the city government.

There was some objection to the quality of the water of the Sudbury River which, like all River water, was subject to periods when it contained decayed vegetable life. The problem could be alleviated, it was known, by storing the water for a time and exposing it to the air. They proposed storage basins on the River itself, and diverting some of the River to Farm Pond, which would act as a natural storage reservoir.

The Boston Water Works were expanded once again with the annexation of Charlestown in 1873. Under the terms of the Annexation the Mystic Water Board was to remain as it was until the City Council of Boston decided to merge it with the Cochituate. But some in City Government felt that the rapid growth of the City required a new Water Board and held out the possibility of going to the State Legislature to create one.

In 1874, there was considerable discussion regarding finding an additional supply of water for Charlestown - East Boston by connecting the Mystic Lake with the Shawshine, Concord and Merrimack Rivers, or one of them, or by use of the Old Middlesex Canal, which because of the arrival of the Railroad had become obsolete as a means of transport.

The City of Boston was slowly but inexorably taking or planning to take for its own use much of the watershed of Eastern Massachusetts. The objection of the Citizens of Framingham in 1846 that their water should not be taken to feed the wasteful habits of the City's had by now become a fact. Yet the City did not exist in a vacuum and its growth was being matched, in different measure, by the Cities

and Towns which surrounded it. Talk of metropolitization in the quest for water was beginning to accelerate.

In their annual report of 1874, the Cochituate Water Board said this:

"It seems proper to take into consideration in this supply of water the Towns of West Roxbury, Brookline, Newton, Brighton, and Hyde Park, all of which, as well as Boston, are situated upon an island formed by the Harbor, and the Charles and Neponset Rivers and their connecting stream, Mother Brook".

It hardly admitted to subdivision while the growth of Boston continuted unabated. In 1870, not yet fifty years after the small Town had abandoned that form of Government and had become a City, its population was 287,787. In fifty years it was supposed there would be 987,919 living there, almost a million inhabitants.

The attempt to supply the needs of so many at the expense of the surrounding Communities would be unconscionable, and dangerous. Foresighted men began to take seriously the necessity of a Metropolitan Water and a Metropolitan Sewer System.

The City Council felt that the time had now come for the merger of the Cochituate and Mystic Water Boards into the Boston Water Board. The Board would consist of three members, each serving staggered three year terms and appointed by the Mayor. The City Engineer would be Consulting Engineer to the Board. The revenues of the Mystic Lake Works would be kept in a separate account and continued to be used to pay off the bonds sold to build those works. The necessary Ordinance was passed on April 16, 1874.

The City Council had appropriated the $500,000. to begin surveys and landtakings along the route of the Works from the Sudbury River, but strong contention by some of the land owners who faced loss of their property that the present Water Board lacked the legal authority of emminent domain, caused the Council to hesitate. Some agreed that indeed the property owners might, as they had threatened to do, get injunctive relief.

Mayor Cobb pointed out to them his dilemma, the Water Board had either to continue the taking of the necessary property or pay the contractors off and close down the project. If, he maintained, the present Water Board had not the required power which he believed they had then the Council itself certainly had it under the Original Water Act, and could delegate it to the Board. The majority agreed with him and decided the work should continue.

The last report of the Cochituate Water Board, that of March 1876, reported substantial progress on the Farm Pond to Chestnut Hill conduit which would be 15 3/4 miles long. It had been divided into 20 sections for construction purposes. The Board, which had first met on January 2, 1851, reported that the total cost of the Boston Water Works as of May 1, 1876, had been $11,994,479.78.

There was some grumbling from the owners of manufactories in the City to the effect that the cost of Boston water was higher than other cities and they were finding it difficult to compete. The Common Council requested the Board to reduce the cost from two pennies per hundred metered gallons to one.

The new Water Board was appointed by the Mayor on July 6, 1876, confirmed by the City Council on July 25th and entered upon their duties on the 31st. Timothy T. Sawyer, Chairman.

The Board immediately realized that they were beset with claims for damages along the route of Sudbury Water Works. They hired the distinguished (Civil War General, Governor of Massachusetts) lawyer, Benjamin F. Butler. He was assited by Linus M. Child, Esq. to represent the City.

The Board reported the Cochituate Department in good shape and the Lake with the help of the Sudbury water had a good supply. The Engineer recommended that a third engine with a capacity of 3,000,000 gallons and a new boiler be erected at once for the high service, but they demurred, feeling that high service equipment would be abandoned in a few years in favor of a pumping station at Chestnut Hill. The Mystic Division was also found to be in good shape. They granted a ½ cent decrease in the metered water charge to manufacturers instead of the full penny which had been requested. The other members of the Board were Leonard R. Cutter and Albert Stanwood. By 1879 the Sudbury River - Farm Pond Works were fully operational - 10,271,800 gallons per day were being sent to the Chestnut Hill Reservoir, 411,300,000 gallons had been diverted to Lake Cochituate. The average daily consumption from Mystic Lake was 8,883,470 gallons, and from Cochituate - Sudbury 25,696,900 for a total of 34,580,370. Henry W. Wightman was the City Engineer and Consulting Engineer to the Water Board. Nevertheless, despite this availability of so huge a supply, the members of the Board

were constrained to say in their 1881 annual report:

"With all the appliances at the command of the City, it is still a work of difficulty to keep the resources of the Works equal to the growing demands made upon them, and the Board often finds themselves in the embarrassing position of being obligated to refuse applications for extensions and use of the water, especially in the high service districts, as a result".

The Board asked permission to enlarge the works once again, in several important aspects. It was already building a new storage basin on the Sudbury River.

The Legislature, on April 15, 1881, gave the City authority to place meters on any building it supplied with water, except in cases of tenements containing from one to three tenements, in which case they would have to get permission of the owner. In all tenements the owner would be responsible for the water bill.

The Lake Cochituate water once more turned sour, and then was shut off, allowing extensive cleaning and repairs to the aqueduct. The plan of the Water Board to sell the abandoned Beacon Hill Reservoir and to get some money to pay for some of the cost of the Chestnut Hill Reservoir works seemed in jeopardy when on November 27, 1880, the City seized the reservoir. The plan of the City was to build a Court House there. (After much bickering, the Water Board did get it back, where upon it sold it to the Commonwealth of Massachusetts. On the foundation of the Beacon Hill Reservoir now stands the State House Annex. The foundation of that Annex with its basement and sub-basement, attests to the fact that the space

once held millions of gallons of water. Workers there say it's still damp). The residents of Noodle Island were complaining again. When they continually complained that the Mystic Lake water was awful, the East Boston Works were detached from that source and put on the Cochituate - Sudbury supply. They now groused about the lack of pressure. There were only two solutions to the problem they were told, Back to Mystic Water or increase the size of the pipe from Boston. But the Board thought that the $80,000. that it would cost was too much. What they would do was to put a (Deacon) meter to work, the consequent decrease in use would increase the pressure, they were sure.

In 1883, the City Council wanted the Water Board to tell them why there were still two Water Registrars, one for the Sudbury-Cochituate Works and one for the Mystic. The Board reminded the Council that at first the two had to be separate to make sure the income from the Mystic was used to retire the Mystic Water Bonds and since the system had worked so well, they haden't bothered to change it. Some Councilors suspected patronage. On January 31, 1896 the Boston Water Board was abolished and replaced by a Water Department to be over seen by one Commissioner.

Although the City had an existing law changed in 1884 to allow it to go to the Supreme Judicial Court to obtain injunctions against anyone found polluting its water supply, the supply quality continued to deteriorate. In May of 1886, a committee to investigate the problem had been appointed by the Suffolk County District Medical Society. It found the tributaries to Wedge Pond, which emptied in Mystic Lake and the upper portions of the Lake itself

were still being contaminated by tanneries and other factories. The tanneries not connected with the Mystic sewer built by the City were attempting to minimize pollution by subsidence and filteration, but the results of those methods were entirely unsatisfactory, the Doctors said. As also were the attempts to cure the problem of the discharge from pirvies, water closets and sinks. Even when the inhabitants took the trouble to discharge their waste into cess pools, the solids, Doctors George S. Shuttuck and Henry J. Barnes concluded, could hardly be expected to depurate before they reached streams by subsoil currents. Since the City was contemplating abandoning the Mystic as soon as an additional source could be found, the Committee recommended that a connection be made on the south side of the Charles River so the Cochituate water could be brought to Charlestown.

The City was having trouble with its meters. In a report to Mayor O'Brien, a commission appointed to test their effectiveness stated that the tenement meters were worthless and the Crown and Worthinton Meters almost the same. When the Water Commissioners purchased the Jamaica Plain Aqueduct Corporation, they ended up only buying the rights to supply water to Boston. Now the corporation wanted to sell all its property to the City. This action was urged on the City Council. The price was $100,000. and since the Pond and adjoining property would soon be needed for the new Parks system it seemed the best thing to do. If the price was unsatisfactory to the City, then three men, one each appointed by the parties to the transaction and the third by the other two would decide the price. The act of 1886 which gave the City the authority to purchase the property required acceptance by a two-thirds vote

of the City Council and the Council did not give it.

In 1889, the City Council gave authorization to the Water Board to take more of the land around the Sudbury River and more of its watershid and to build a fifth basis, the cost of which would be $1,045,000.

Continually displeased as to the effectiveness of its water meters, the City began in 1890 to require monthly reports on how any were out of service, sold, being repaired or purchased.

As was the custom, men were laid off during the winter months when no construction could take place. The Aldermen inquired if the remaining work force, 27 men in the Eastern Division and 62 in the Mystic could not be put on half time so some of the men laid off could have work. No, they were told, since those retained were not common laborers, but men whose skill was required to keep the Works operating.

Because of the scandal allegedly involving one of the members of the Water Board, an allegation which was never proven, there was an attempt in 1891 to do away with the Water Board and delegate its duties to the City Engineer. The Corporation Council ruled that this could not be done since the legislation under whose authority the Board functioned required three members.

It was decided that the sixth basin on the Sudbury River had to be built, although Basin number 4 and 5 were not as yet completed. This latest basin would have a capacity of 1,500,000 gallons. The dam across the valley would be 1,500 feet in length and consist of an earth embankment with a center core wall of concrete extending to bed rock. It was to be located in the towns of Ashland and

Hopkington. The core was 8 feet thick at the base and about 3 feet at the top of the dam.

By this time, 1894, the Water Board had been split into what were essentially three Departments: Engineering, for the construction and maintainance of the Works, under the City Engineer; the Water Income Department for the assessing and collection of the rents under the Water Registrar; and the Water Supply Department, in charge of seeing to the quality and quantity of the water, under the charge of the Water Board. In this way, those who wished to abolish the three member Water Board had effectively lessened their power and responsibilities.

Desmond Fitzgerald, who was later to write a brief history of the works, was the Engineer for the Water Supply Department in 1895. In his report of that year, Fitzgerald's superior, the City Engineer, reported that the daily average use of water was 41,500,000 gallons from Cochituate - Sudbury. Since the capacity of the works was estimated to be 46,650,000, it was evident that availability of supply might be inadequate before Basin number five could be completed. The average daily use from Mystic was 11,500,000, far in excess of the capacity of those works.

The year was exceptionally dry and the water became so low at the Mystic that sea water had seeped into the Mystic and 40,000 people in Charlestown had to be supplied from Cochituate - Sudbury for four months. When Basin number 5 is completed the capacity of the Works will be 61,500,000 gallons and since daily consumption is now 57,000,000 that quantity will soon exceed the supply. The

Mystic soon must be abandoned as the quality of water is no longer acceptable and getting worse, and there are too many people living on the watershed to make imporvements worthwhile. The completion of Basin 5 will complete the Sudbury Works, so it is apparent that, once again, anothe source of additional supply must be found for the City voracious lust water.

The present Works also required expansion. The increased use of the water in the High Service Area made the supply Mains from the Fisher Hill (Corey Hill) Reservoir and those in the Roxbury District inadequate to furnish a supply without an excessive loss of head. At times the Parker Hill Reservoir in the Roxbury District has been nearly emptied and the people on the higher land have been entirely deprived of their supply. The City Engineer recommended the laying of a 46-inch pipe from the juncture of Fisher Hill Avenue and Boylston Street to the corner of Huntington Avenue and Heath Street, with a connection at Wait Street for the supply of the Parker HillReservoir and another branch of a 36-inch main to be carried through Heath Street to across the Roxbury District. The new pumping engine at Chestnut Hill and Mystic stations will furnish sufficient pumping capacity, he was sure, to meet the requirments at those stations for the next five years.

As a result of the investigation by the Metropolitan Water Commission into the problems and potentials of supplying with water an ever rapidly growing Metropolitan Area, where a large number of the Citizens of Massachuestts lived, the Great and General Court, in a truely historical action, created on June 5, 1895,

by enactment of Chapter 488 of the acts of 1895, a Metropolitan Water Board, the first in the nation.

The three Commissioners appointed by the Governor were to see water for the inhabitants of the Cities of Boston, Chelsea, Everett, Malden, Medford, Newton, and Somerville and the Towns of Belmont, Hyde Park, Melrose, Revere, Watertown and Winthrop. That ambitious beginning was to grow into the massive Water Works, a first unique, and still the envy of many water short Metropolitan Areas. The system today supplies thirty-four Cities and Towns with well over 116 billions of gallons of water a day.

The Commissioners were to take all of the Boston Water Works outside the boundaries of the City which they felt they needed for their purposes. In addition to the City's existing sources the new entity would take water from the Nashua River at a point above the dam at Lancaster Mills in the Town of Lancaster.

As the first step in the metropolitization of water supply, the new Board hooked up to the Chestnut Hill Reservoir conncetions to the Mains of Somerville and Chelsea and tied the Charlestown section of Boston into Spot Pond.

On January 1, 1898, the Metropolitan Water Board made a taking of the sources of supply outside the City of Boston, including basins, aqueducts, mains, etc., except the Fisher Hill Reservoir and the Sudbury River Works.

It had been fifty years, one month and seven days since the arrival on that joyous day of the pure, cool and healthy water of Long Pond - Lake Cochituate. The total cost of the Boston Water Works had been $26,180,203.26. Loans totaling $17,911,273.98 of that amount were still outstanding.

Chapter XV

In the early part of the last half of the Nineteenth Century, the American correspondent of the London Times wrote to his Editor that if you stood long enough outside Ticknor's Old Corner Book Store at School or Washington Streets in Boston, you would eventually encounter the greater part of the intelligence of the New World.

He was correct, of course. Thoreau, Emerson, Whittier, Lowell would eventually be by, as would the great Divines whose firey oratory provided the moral impetus for the Civil War: William Lloyd Garrison, Edward Everett Hale, and John Freeman Clark.

To that time Boston was essentially an English Town where one might walk from one end to the other in a liesurely day's effort. There was a section for those who practiced the Law; one for those engaged in Commerce; another for Banking and every participant in each endeavor was sure to know his fellows on sight.

By the turn of the Century, however, the changes in the City were profound. Its growth, caused by both heavy immigration and the annexation of Roxbury, Charlestown, and Dorchester had been phenomenal. In 1900 its population was one half million and it ranked with the great Cities of America in number of inhabitants, progress and commerce, if not in physical size.

It had become obvious, as it had in 1822 when Boston abandoned the town form of Government to establish itself as a City, that

the City's growth and complexity required a restructuring of its Government. In 1909 a new Charter was adopted ending the bicameral Board of Aldermen and Common Council and substituting for it a City Council, one Councillor to be elected from each Ward. That new Charter also strengthened the hand of the Mayor delineating the power of that office and of the Council along the lines of administrative and legislative branches.

One result of the new structure was the combining of three heretofore independent departments whose fuctions were obviously closely related - Water and Sewer, Engineering and Street laying out. In 1910, Mayor John H. Fitzgerald signed an Ordinance incorporating those functions into a department of Public Works. The ordinance stipulated that the Department be headed up by "a Civil Engineer of recognized standing in his profession." Mayor Fitzgerald, with the approval of the Council, selected L.K. Bourke to be the first Commissioner of the Department of Public Works, an agency which was to see to the delivery of most of the essential services the City provided for its citizens.

Since the City was no longer in the business of seeking a supply of water, its function now was to see to it that delivery system in the City was kept in the proper condition. F.A. McInnes, the new head of the Water and Sewer Divisions of the Department of Public Works found the Water Works to be in good shape, recently improved by the extension of the High Service to Dorchester Valley. Average daily consumption was 85,511,500 gallons, but that represented a reduction in the daily per capita use from 130 gallons to 124.

He found that he had a personnel problem in the Sewer Works however, many of his men were quite old Having given a great number of years to the service of the City. They had no pension and had to continue to work far beyond the time that they could put in a proper days work. He urged the Mayor and Council to consider providing these men with the means to retire.

In 1916, Mayor James Michael Curley made a decision to contract out most of the Department's work, a decision which forced the transfer of twenty men to other City Departments. The water Division was planning to build a much needed pumping station for the Fire Department in the Downtown area of the City. The Engineer of the Water Works felt that he had selected the best possible location, the hill on Boston Common. This good engineering but poor political decision caused a hue and cry. Looking elsewhere, he choose the Charlesbank in the vicinity of Otter Street. By that time Beacon Hill had become fashionable and its residents influential, "No", they said. They liked his next choice only slightly better. Under the ground on Charles Street midway between Beacon and Boylston Streets. The poor man had finally to settle for a site at the foot of Fort Point Channel near the old Mount Washington Brdige. A location without a constituency.

The effort to expand the separate systems, one for water and the other for sewage, continued. In 1917, a new system of sanitary and storm sewers was laid down Broadway in Dorchester eventually to run to the Dorchester tunnel which would take

the sewage to Moon island by gravity. Here it would be pumped up into the two storage reservoirs,there to be held until the proper flow of the tide allowed to be discharged into the Harbor to be taken out into Massachusetts Bay on the receding tide. In theory an effective way to dispose of the waste, in practice, less so.

Continued extension of the High Pressure Service was also paramount and Tremont Street was connected to that service in 1918. The number of High Service hydrants in the business district now stood at 188.

The report of the Department of Public Works in 1923 stated that there was 994.66 miles of common and connecting sewers laid in 587.86 miles of streets and that the Calf Pasture pumping station had pumped no less than 32,276,342 gallons of sewerage in 1922 at a cost a little above $150,000.

Although, "motor vehicles" by 1924 predominated, a goodly number of horses were still used by both the Water and Sewer Division. As it had been to his predecessors, the $1,000,000 appropriated annually by the City for Sewer work was inadequate the Division Engineer stated, especially in view of inflation. He need 50% more.

Slowly but inexorably the beginning years of the deepening depression was bringing all work on the system to a halt. In 1930, only three and one third miles of new sewer line was laid and less than eight of water pipe. Anticipating the Public Works that would soon be financed from Washington, Mayor Curley

sought permission from the Legislature to borrow $3,000,000 for the modernizing of the Sewer System and to put as many men to work as he could. He pointed out that the scheme would only add a few pennies to the tax rate.

During many years of the history of both the Water and Sewer Works the City had been forced to react, with little or no real planning, to continued growth of the City. Where people went, water and sewer must go, and hopefully first. As a result, particularly in the case of the High Service, there were many dead end lines. The construction of the tunnel to East Boston and the widening of Cross Street provided the Water Division with the opportunity to tie many of these dead ends.

President Roosevelt's efforts to ease the unemployment caused by the Depression resulted in most of the work of the Water Division in 1937 being done not by the Department of the Public Works but by the Work Projects Administration, the Water Division merely acting in the capacity of Supervising Engineer. The 2,500 men employed by the DPW in 1938 was the lowest number employed since the Department had been established.

More of the slowly disappearing from view Stoney Brook, this time a section in West Roxbury, was covered over by the WPA.

One of the steam pumps at Calf Pasture was beyond repair and it was decided to replace it with an electric one. The new machinery worked so well, the Commissioner considered replacing the other steam pump with an electric one also. The operation of the steam pipe took eight men. The newly created Water Income Division reported a surplus of $654,998.45 instead

of the deficits that had prevailed in previous years. The method used to collect delinquent accounts was to lower the water pressure of the culprit, not so far as to endanger health, but low enough to make things uncomfortable.

In 1942, the Water Division was further restructured to include Water, Engineer, and Distribution Branches and a Business Office. Just as it had done in the years of the Depression, the advent of the second World War virtually halted all construction and much maintenance activity in both the Water and Sewer Works as more and more men were given leaves of absence to go off to War. Much work was contracted out, but the private contractors had their own problems obtaining the necessary men and material. The situation held some irony since the cause of the shortage of men and material, the War, also created an increased demand for water and sewer services as government agencies and the private sector expanded in the War effort. The lack of work and the increased prosperity brought on by the War resulted in a surplus in the Water Division of $1,350,224.10 in 1944.

By War's end a great amount of maintenance work had accumulated and those veterans who choose to return to the Water and Sewer Division were put to work immediately. It was assumed that the dismantling of the War effort would decrease the demand for extention of the Works, but the great post-war desire of couples to own a home of their own resulted in large scale building in areas of the City heretofore only sparsely settled. Once again, the Water and Sewer Divisions found themselves in a period of expansion.

The Engineer of the Sewer Department was pleased to note in his 1948 Annual Report to the Commissioner of Public Works that the plans for the Sewage Treatment Plant at the Calf Pasture were almost ready.

In 1889 the Massachusetts Legislature had created a Metropolitan Sewage District as a companion of the Metropolitan Water District. By 1895 the Sewer District had extended the Boston Main Drainage System to communities on the North of the City and constructed interceptor sewers, pumping facilities and an outfall on Deer Island. The Metropolitan system was now dumping untreated sewage into the Bay on the North from Deer Island and the City of Boston equally untreated waste on the South from Moon Island. The situation festering like its products, was becoming intolerable. A third system of sewer outfalls was built off Nut Island in 1904 compounding the almost systematic polluting of the Harbor.

In 1940, the Massachusetts Legislature passed Chapter 598 which authorized the City of Boston to build a Treatment Plant at Calf Pasture. The war interfered. In 1950, Mayor John B. Hynes returned George Hyland as Commissioner of Public Works after a five year absence from that position. All Hyland had of the proposed Treatment Plant was a set of plans. Plans he did not like. The existing Act authorizing the Treatment Plant by then called for construction to start not later than April 1, 1950 and that it be completed by July of 1955. To comply with the law, Hyland did some token work at the Calf Pasture, but little else owing, he said, "to the unavailability

of the appropriation."

Hyland realized, as did others, that a partial solution to the pollution of the harbor was no solution at all. It called for a metropolitan effort. The Metropolitan District Commission built two deep rock tunnels in 1952, one to bring the raw sewage to Nut Island where a treatment plant was built. In 1968, a second treatment plant was built on Deer Island fed from the other rock tunnel. Except for emergency use during extreme wet weather, the Moon Island outfall is no longer used. This source and overflow from combined storm water and sewage sources, particularly affecting Dorchester Bay, the Charles and Neponset Rivers and the Inner harbor remain sources of Pollution yet, but suggestions have been made that a series of stormwater treatment stations would eliminate that situation.

Following activation of the Deer Island Treatment Plant and the operation of year round chlorination, several beaches in Winthrop were re-opened and commercial shell fish harvesting in the area was once more allowed.

The idea of a Metropolitan agency for the supplying of water and the disposal of waste proved irresistable. The Metropolitan District Commission would eventually supply water, all or part of their need, to Thirty-four cities and towns and dispose of the waste of forty-three, most having both services. But, like its ancestor, the Boston Water Works, the Metropolitan Water Works found the demand constantly threatening to outstrip the supply.

The Commission, which also has a Park Service and a Police Force, had finished its works to take water from the Wachusetts River in 1908, but this source was soon inadequate as more cities and towns joined the system and demand increased. A permanent solution, it was felt at the time, would

be the creation of a system of Reservoirs on different watersheds, culminating in the building of the massive Quabbin Reservoir, sixty five miles from Boston, almost half the distance west across the state.

Taking by the power of Emminent Domain granted to it by the Legislature, all or part of several towns constructed a thirty-nine square mile Reservoir. This man-made lake stretches 18 miles in length and has 118 miles of shore line. Completed in 1939 it utilizes the Swift River, a tributary of the Connecticut. After completion of the massive earthen dam, at the time the largest in the world, it took seven years for the Reservoir to reach its capacity of 412 billion gallons of water.

Such a great supply to satisfy the demands of so many, had to have a large delivery system. The water is delivered through an intricate system of lesser reservoirs, conduits, pumping stations and deep rock tunnels. It was the completion of one of these tunnels in 1950 which when connected to the Boston Works, dramatically increased the High Service Pressure in the city. This in turn allowed for the discontinuance (except in emergency siutations) of the Chestnut Hill Reservoir, which since it had the low service, increased that services pressure also.

Association with the Metropolitan Systems did not come cheaply. The assessment for the City for its water in 1952 was $1,636,681.00 and for the sewers services, $574,385.81. In 1953 the Commission doubled its water rates and Boston consequently increased its to $2.00 for the 1st 20,000 cubic feet, $1.90 for the next 20,000 and $1.70 for the third up to 1,000,000 cubic feet when the charge would be $1.15 per cubic foot.

There had been some conflict over the years as to the responsibility in certain situations of the Board of Street Commissioners, the Street Laying out Department and the Water and Sewer Divisions of the Public Works Department. To remedy the situation, the Public Works Department was re-

structured in 1955, with all functions of the Street Laying Out and Street Commissioners having any connection with the Water and Sewer Works being transferred to the Department of Public Works.

The architects, engineers and builders who had put thousands of tons of buildings on piles driven through the filled in land of the Back Bay thought of it as that, man made land, but to Nature it was still a Bay. There was constant danger that the water level would fall below the tops of the wooden piles, piles indestructable as long as they were submerged, but quick to rot if not. It was a situation that bore watching and indeed the Trinity Church in Copley Square, had a Water Level Committee for just that purpose.

Some time between 1929 and 1933, the Committee concluded that the City's sewer on St. James Avenue was contributing to the fluctuating water level beneath their magnificant church. To alleviate the problem, the city installed a weir and a butterfly gate in the sewer. Meticulous records kept by the Water Committee indicated that over the years the water level was generally satisfactory, but not so when the gate was open for a protracted time. The Water Divisions solution to the problem was to store water in the Boylston Street surface drain to replace water under the church as needed.

Chapter XVI

The hurricane winds of the not so gentle lady called Diane, were predicted to hit Boston. They did not, but the storms rain did. In thirty six hours on August 18 and 19, 1955, eleven and ninety four hundreds inches of rain deluged the city. In one twenty four hour period of those two days, over eight inches fell. Despite the size they had grown to over the years, the storm drains and separate sewer were unable to cope with that amount of water. In the reverse of what was supposed to happen, water began to run out of sewers and drains rather than into them. Extensive areas of the South End, Back Bay and Roxbury (the low lands which had always given trouble), were flooded. The Water Division was hard pressed to help everyone but with the help of every pump they could get from Contractors, the Civil Defense Agency and the Fire Department they managed to pump many out.

The large taskforce of men and machinery had hardly finished that emergency assistance when the Charles and Neponset Rivers and Mother Brook reached their crest, flooding the Island section of Hyde Park and Belnel Village in Dorchester. In some places water reached seven feet in depth. It was deep enough in the village to require rowboats to rescue residents.

Cellars in those sections could not be pumped out until the water receded. An attempt was made to lower the depth of flow on the Neponset and Mother Brook by cleaning debris from the crest of the Union Waste Paper Mill in Dedham, from Jenkins Dam and the upstream side of the Central Avenue bridge, both in Dorchester Lower Mills. The owners of the Jenkins Dam and the Walter Baker Dam were induced to raise the day sluices to their full openings in order to lower the depth upstream.

In his report for the year of 1957, the Engineer of the Water Division was able to report the end of a project which had gone on for almost one hundred years: "The Stoney Brook has been entirely closed with a concrete conduit on September 28, 1957." Robert P. Shea succeeded George Hyland as Commissioner of Public Works in 1958. He pointed out to Mayor Hynes that the City every year routinely borrowed $1,000,000 for sewer work and that the Sewer Division usually received a $150,000 down payment by July 1st from taxes. But the proceeds of loan came so late in the year that projects started had to be carried into the following year. Would the Mayor, he asked, send the request for authority to borrow to the City Council earlier, or better still, could he not have a two year appropriation instead of one?

When John Collins took office as Mayor in 1960, his choice from Commissioner of Public Works was James W. Haley. Edward G. Powers was Sewer Divion Engineer and Daniel M. Sullivan continued as Water Division Engineer*. Commissioner Haley's first business was to reorganize the department. He created four divions, Engineering, Highway, Sewer and Sanitary. There was also a central office. Under the Water Division there were to be three sections, Construction Maintenance and Revenue. Under the Sewer Division, two, Construction and Maintenance. Haley divided the City into three areas, each having a

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*Daniel M. Sullivan came to work in Water Division, August 23, 1911 and was Division Engineer for many years. His son John P. Sullivan arrived on April 22, 1948 and himself was Division Engineer, until being appointed as Director of Operations for the newly created Boston Water and Sewer Commission in 1977. On May 24, 1972 John's son, John P. Sullivan, Jr. went to work with the Water Division, and is now Director of Engineering, or in effect Engineer for both the Water and Sewer Divisions.

supervisor for each of the divisions and a foreman for the garage in each area.

Up to that time, tax exempt property was being afforded the sewerage service free on charge. In 1962, the City Council passed an ordinance charging each of those estates discharging into the City's Sewers at the rate of $1.00 per cubic foot of water used.

In the early part of the 1960's, Boston was in the midst of a building boom and that presented an opportunity. For years there had been an on-going attempt to convert those sewers being used for both water and sewer discharge to a separate system, one for water and one for sewage, but, a substantial area of the City still had a combined system that had not been converted because of the cost to the property owners of changing their plumbing to accomodate the separate systems. Now, with large sections of the City being demolished for renewal, particularly the Old West End, separate systems could be easily built and that was done even in those sections where no Works would be needed until a later date. This method would also save money when the anticipated tying in of the Metropolitan District Sewer took place.

By the decade of the 1960's, Bostons Sewer Works had grown to 1,303.19 miles of common sewers and 40.93 of interceptors; pumping stations at the Calf Pasture, Union Park Street, Symphony Station, Summer Street and Sullivan Square. The pumping station at the Calf Pasture was raising 27,813,000,000 gallons, an average of 76,000,000 gallons of waste each day at a cost of $7,240,000.

The Water Works had 1,045.5 miles of pipes including 18.64 miles of High Pressure Fire Service, ranging in size from 48 inches and included gates valves, hydrants and other appurtenances.

After some years of debate as to its location and financial feasibility

a three-level garage with a capacity for automobiles was being constructed under Boston Common. The Contractor, The Foundation Company of New York, had piled excavated dirt some twenty-three feet high on the base-ball field there. The weight proved too much for the 42 inch main below the surface. On Thursday morning, April 21, 1960, it gave way, denying water to a large section of the City. The contractor worked around the clock and had normal service restored by 3:00 a.m. on Saturday, the 3rd. The expense, with the exception of $6,000 paid by the City was borne by the culprit.

As the Federally sponsored Works Project Administration played a hand in the Water and Sewer Works during the depression, Federal agencies, looking to refurbish urban areas, would again play a role. In 1965, using an interest free loan of $211,220.28 granted to the City by the Department of Housing and Urban Development, the Department of Public Works commissioned the Engineering firm of Camp, Dresser and McKee to develop the first comprehensive plan for the upgrading of its system of disposing of sewage, including elimination of its contribution to the pollution of the Harbor and adjoining waters from its combined sewers.

The consultants offered four alternatives:

1. Complete separation of all sanitary sewage and storm drainage systems
2. Construction of chlorination detention tanks
3. Construction of surface holding tanks
4. Construction of the deep tunnel plan.

The last one was judged the most efficient and least costly.

It would involve the construction of deep rock storage tunnels, shafts, transmission tunnels, surface connections, and a main pumping station on Deer Island. Using this method, the sewage and storm water would be disposed of well off shore into the Atlantic Ocean, thereby eliminating the pollution of Boston Harbor and adjacent waters. The cost would be enormous, almost

one half a billion dollars, but the City would have to pay only $30,000,000 the rest coming from the Federal and State Governments. The initial construction would be that of a Main Interceptor and Tributory Conduit, a South Boston Pollution Control Conduit, and the East Side Interceptor and the cost would be $37,850,000 of which the City would be responsible for $20,800,000.

At the midway point of the 1960's, consumption of water in Boston had risen to 210 gallons per capita daily. Using a HUD grant of $900,000 the Department of Public Works asked their consulting engineers to draw plans and specifications for two 36-inch mains to be built, one in Charlestown and one in Dorchester.

(The system that finally evolved from the planning and consulting of both the City of Boston and the Metropolitan District Commission takes the sewage from Boston Proper, South Boston, parts of Roxbury , Dorchester and West Roxbury to the Deer Island plant where it is pretreated, primarily treated, chlorinated and discharged. Sewage from Brighton, Hyde Park, and parts of Roxbury, Dorchester and West Roxbury flow into the Metropolitan System and after being treated at the Nut Island Treatment Plant is discharged).

(A small portion of the Dorchester and Milton sewage in the Metropolitan Sewage Area, lying at an elevation too low to drain into the Metropolitan High Level Sewer is discharged through the Boston Main Drainage System).

(The Calf Pasture-Moon Island disposal plan is used only when the weather is so wet that the Metropolitan District Commission facilities have not the capacity to receive all the sewerage and drain water. In that event, the effluent is discharged into the Harbor at Moon Island. The polluting effect is not too severe since the discharge is overwhelmingly water. The danger of pollution rises when, for one reason or another, the MDC facilities cannot take the sewage the City desires it to and the City is forced to discharge the sewage directly into the harbor, untreated.)

In order to qualify for the National Pollution Discharge Elimination System Permit the City needed, the City was required by the Environmental Protection Agency in 1976 to replace several sewers including the Main intercepting sewer, east side intercepting sewer (north and south branches) and the Mt. Vernon Street Sewer. The total cost of the project was estimated by the Consulting engineers to come to $58,000,000 75% of that sum in Federal Grants and 15% in State Grants.

The total consumption of water by the City of Boston from July 1, 1976 to June 30, 1977 was 150,381,600 gallons per day.

The report covering that period from the 1st of July, 1976 to June 30, 1977 would be the last full report that the Water and Sewer Divisions of the Department of Public Works, City of Boston would ever issue.

Chapter XVII

One hundred and forty years had passed since that Saint Patrick's day in 1837 when on Petition of the City of Boston, the Great and General Court of the Commonwealth of Massachusetts had enacted a law creating a Commission of three to look into the locating and procuring a supply of pure, fresh water for its Capital City. On July 18, 1977, in response to a home rule petition initiated by Mayor Kevin H. White and approved by the Boston City Council, the Legislature passed in its final form chapter 436 of the General Laws. That law created the Boston Water and Sewer Commission.

The new Commission like the old, would be made up of three Commissioners, and like the ones which evolved from the first Commission, would have the exclusive responsibility and matching power to operate the Boston Water Works and the Boston Sewer Works.

John S. Howe, Chairman of the Commission, Melvin B. Miller, Vice Chairman of the Commission and Michael J. Rotenberg, Commissioner, were chosen by the Mayor with the approval of the City Council to be the latest successors of Hale, Treadwell and Baldwin. The term of the Commissioners was to be four years, each one staggered. All three would have to be residents of the City, one to have extensive experience in the world of business, and one in the field of accounting and finance. The Commissioners were to appoint an Executive Director and they chose Charles Scales as the first one. The Commissioners also appointed a Treasurer, a Chief Engineer and such other officers as they deemed appropriate.

The Executive Director was given the authority, with the approval of the Commission, to employ legal counsel, financial advisors and other experts he felt necessary to the successful operation of the Commission.

The Commission was given the power to sue, raise money, hold property; the power of eminent domain, to set water and sewer rates, to take whatever action it deemed proper to collect water rents and sewer charges and to take possession of the physical plant of the works as they then stood. Upon the signing of Chapter 436, the Commission issued $45,000,000 in notes, using $25,000,000 of the proceeds to pay off the accumulated deficits of the City's water and sewer receipts accounts; pay the Metropolitan Commission $18,900,000 owed to it for water supplied and sewage treated. The remaining $1,400,000 was deposited with the corporate trustee for necessary commission expenses.

From July 18, 1977 to December 31, 1977, the Works were still operated by the Department of Public Works. On January 1, 1978, the Water and Sewer Commission began to operate them and the employees of the now defunct Water and Sewer Divisions of the Department of Public Works, became employees of the Commission.

Perhaps the best summation of the long and expensive history of the Boston Water Works and the Boston Sewer Works is the reason for its existance as stated in Section I of the law creating the Boston Water and Sewer Commission:

"It is hereby declared that for the benefit of the people of the City of Boston, in order that there be an increase in their commerce, welfare and prosperity and an improvement in their

living conditions it is essential that the City maintain a sound, economical and efficient water supply and distribution system and sanitary sewerage system. . ."

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